SOUTHERN FIELD-CROP ENTERPRISES

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SOUTHERN FIELD-CROP ENTERPRISES

INCLUDING SOIL MANAGEMENT

KARY C. DAVIS, PH. D.
GEORGE PEABODY COLLEGE FOR TEACHERS

FARM ENTERPRISE SERIES

Edited by Kary C. Davis, Ph.D.

SOUTHERN FIELD CROP ENTERPRISES, by several specialists
NORTHERN FIELD CROP ENTERPRISES, by several specialists
LIVE STOCK ENTERPRISES, by several specialists
HORTICULTURAL ENTERPRISES, by K. C. Davis and several specialists

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J. B. LIPPINCOTT COMPANY, Publishers

PHILADELPHIA LONDON CHICAGO

SOUTHERN FIELD-CROP ENTERPRISES

INCLUDING SOIL MANAGEMENT

E. R. ALEXANDER, A.B., B.S., M.S.
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SOUTH CAROLINA

FORREST G. BURD, B.S.
KENTUCKY

J. G. LEE, JR., B.S.
LOUISIANA STATE UNIVERSITY

E. W. GARRIS, B.S., PH.D.
UNIVERSITY OF FLORIDA

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KARY C. DAVIS, PH.D.

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PREFACE

"Field-Crop Enterprises" makes its salute to the teachers of vocational agriculture of the Southern Region.

Twenty-one enterprises are included. Each of the enterprises has been divided into a number of jobs according to the approved plans of job analysis now so commonly followed in the agricultural education of most of the states.

The jobs or teaching units are in turn analyzed into problems for study and discussion. These jobs usually include a fairly complete inventory of the teaching elements in that job. Some of these are operative problems and some are managerial problems. There are very few jobs indeed which do not include problems of both types.

In connection with each group of problems a few activities are suggested for students to perform which should aid in making the teaching more concrete and which should tend to fix the practices and managerial problems more clearly in the student's mind. Teaching is not vocational if it does not carry over into action.

A statement of conditions is attempted for each job. Teachers will find it necessary in most cases to add additional conditions so as to make the job fully applicable to the community or region. In a book of this kind no one person can make statements of the conditions which apply minutely to every community. When a job is chosen for study, changes in statement of conditions should be made to suit the region so far as the instructor and members of the group can determine them.

Aims are given in each of the jobs. Special aims may be in the minds of the instructor or students, and these can be added to those given in the book. The purpose in each job should be to determine standard practices which should be followed in that job. These should be the best methods to be found, taking into account scientific teachings, economy of labor and money, and results secured. The standard practices must vary under different conditions, and teachers must judge and decide upon the conditions of the region, the attainments of the students, the capital required, and other factors involved.

Local inquiry questions are offered or suggested in all jobs for this reason.

Job analysis is the organization of subject matter. It is an analysis of content and a setting forth of problems involved in the job. The jobs included here as teaching units are the same as the natural farm jobs or

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work units of the farm. In other words, the analysis of the enterprise into jobs is merely a selection of the farm operations included in the enterprise. Vocational agriculture should always have as its aim the solving of the problems involved in farm jobs.

A teaching unit is therefore a portion of the content of an enterprise which can be easily handled as the teaching job. The basis for separation should be the farm aim or farm unit of work.

Local adaptations must be made in every job. Students are always directed to find the local situation with reference to each job. The reports from these investigations or local inquiries should be brought before the class when the job is undertaken. In the classroom, the blackboard, the chart, and written or oral reports are valuable means of setting forth conditions to the whole group.

The thoughtful teacher desires to make assignments for each day which will cause the boys to think and reason. In this text the busy teacher will find much help, since concise, pointed directions are given as assignments for each job. With these directions there can be no doubt as to what is expected of students. Their interest is immediately aroused and they attack the new problems of each job with an earnestness which is really inspiring to their parents and teacher.

Authors and Other Specialists

The authors of the sections are shown in each case. They are all engaged in vocational agricultural education as teacher trainers, or in supervision of agricultural teaching. They have the teacher's point of view more clearly in mind than any group of authors that could possibly be assembled from other types of work. They know the teacher's needs and have here tried to meet those needs. They know the importance of teaching according to enterprise units. They believe in job analysis as a helpful method of organizing the subject matter. They believe in maintaining a close connection between classroom work and farm jobs. They believe in tying up closely the experience of farmers with the studies of future farmers. To accomplish these purposes they have outlined and written these enterprises.

Specialists, subject-matter experts, and other authorities were asked by the author of each section to read the section and criticise it to help make it better. The work of these experts has assisted each author in making his section up-to-date, authoritative, and reliable, so far as it is possible to do so. Experiment station findings have been included where space would allow and the latest teachings of the experiment stations have been included in all the enterprises. Credit is given for illustrations not supplied by the author of the enterprises.

Cotton Enterprise.—Author, E. R. Alexander, A.B., B.S., M.S., College Station, Texas; Professor Agricultural Education, Texas Agricultural College. Read and criticised by J. J. Brown, Assistant Director Agricultural Education, Austin, Texas.

Corn Enterprise.—Author, Dudley M. Clements, B.S.A., M.A., Nashville, Tenn.; State Supervisor Vocational Agriculture. Also author of several bulletins and papers. Read and criticised by M. J. Funchess, Director Agricultural Experiment Station, Auburn, Ala.

Small-Grain Enterprise.—Author, E. B. Matthew, A.B., M.S., Little Rock, Ark.; State Supervisor Vocational Agricultural Education. Also author of bulletins on Vocational Agriculture, numerous articles in farm journals and the daily press. Read and criticised by D. J. Burleson, Agronomy expert, University of Arkansas; J. C. McAmis, Extension Crop Specialist, University of Tennessee.

Sorghum Enterprises.—Author, Edwin B. Nelms, B.L., B.S., Oklahoma City, Okla.; State Supervisor Vocational Agricultural Education. Also author of many short papers. Read and criticised by A. Daane, Agronomist, Oklahoma Agricultural College; Karl H. Klages, Assistant Agronomist, Oklahoma Agricultural College; John B. Sieglinger, Assistant Agronomist, U. S. Bureau Plant Industry, Woodford Field Station, Okla.

Grass and Clover Enterprises.—Author, Zora M. Smith, A.B., B.S.A., A.M., Lafayette, Ind.; Professor Agricultural Education, Purdue Univ.; State Director Vocational Education; State Supervisor Agricultural Education; also author numerous bulletins, circulars and reports. Read and criticised by Martin L. Fisher, Professor of Agronomy, Purdue University.

Alfalfa Enterprise.—Author, Ray I. Throckmorton, B.S., M.S., Manhattan, Kansas; Professor Agronomy and Head of Department of Agronomy, State Agricultural College. Also author of numerous Kansas bulletins. Read and criticised by Dr. W. H. Stevenson, Head Department Agronomy, Iowa State College; E. E. Etheridge, Professor Field Crops, University Missouri; W. W. Burr, Agronomist, Nebraska University.

Peanut, Soybean and Cowpea, and Other Annual Legume Enterprises.—Author, Walter S. Newman, B.A., M.S., Richmond, Va.; State Supervisor Agricultural Education. Also author of *Who's Who among Holstein-Friesians* and *Long Time Program in Vocational Agriculture*. Read and criticised by C. T. Batten, Superintendent Holland Sub-Station, Va.

Irish Potato Enterprise.—Author, J. K. Coggin, B.S., M.S.A., Raleigh, N. C.; Assistant Supervisor Agricultural Education. Read and

criticised by Dr. R. Y. Winters and Robert Schmidt, Experiment Station, N. C. State College of Agriculture, Raleigh, N. C.

Sweet Potato Enterprise.—Author, W. H. Garrison, B.S., M. A. Columbia, S. C.; Assistant State Supervisor Agricultural Education. Read and criticised by A. M. Musser, Acting Head Horticultural Division, Clemson College, S. C.; Robert Schmidt, Station Vegetable Research Specialist, Raleigh, N. C.; G. P. Hoffman, Penny-Gwinn Farms, Green Cove Springs, Fla.

Tobacco Enterprise.—Author, Forrest G. Burd, B.S., Frankfort, Ky.; Assistant State Supervisor of Vocational Agriculture. Also author of monograph, Teaching Agriculture in Kentucky High Schools. Read and criticised by E. J. Kennedy, Professor Farm Crops, University of Kentucky; Dr. T. K. Wolfe, Professor Agronomy, Blacksburg, Va.

Rice and Sugar Cane Enterprise.—Author, Jordan G. Lee, Jr., B.S., Baton Rouge, La.; Professor Agricultural Education, Louisiana State Univ. Also co-author *Farm Crops*, and several bulletins. Read and criticised by the following specialists of Louisiana State University: Dr. C. W. Edgerton, Plant Pathologist; Dr. W. E. Hinds, Entomologist; W. G. Taggart, Assistant Director Louisiana Sugar Station; W. R. Hendrix, Agronomist; J. M. Jenkins, Assistant Director Rice Station.

Truck Crops Enterprise.—Author, Edward W. Garris, B.S., M.A., Ph.D., Gainesville, Fla.; Professor Agricultural Education, University of Florida; formerly State Supervisor Agricultural Education. Also author of Florida State bulletins. Read and criticised by Geo. P. Hoffman, Horticulturist, Penny-Gwinn Institute of Applied Agriculture, Green Cove Springs, Fla.

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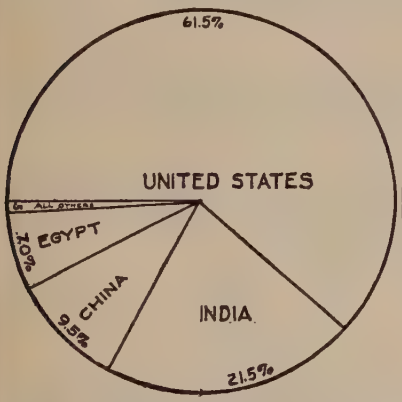
COTTON ENTERPRISE

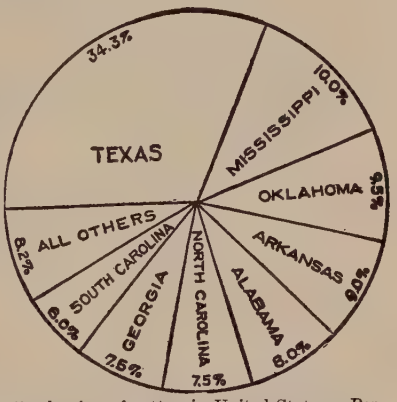
By E. R. Alexander, A.B., B.S., M.S.

Professor Agricultural Education, Texas Agricultural College

Analysis into Jobs.—The following ten jobs in the cotton enterprise include the chief operations in growing and marketing this crop. References are to U. S. Farmers' Bulletins, and U. S. D. A. Bulletins and Circulars. See also books on cotton by Savely and Mercier and by Collins.



World's production of cotton. Percentages by countries. 1922–1926 inclusive.



Production of cotton in United States. Percentages by states. 1922–1926 inclusive.

(Chamberlain's Geography.)

1. Determining the possibilities, acreage and soil for cotton. 501.
2. Choosing the type and variety. 1384, 1432.
3. Selecting and testing seed. U.S.D.A. Bul. 1056, Circ. 205.
4. Buying and mixing fertilizers for cotton.
5. Preparing soil and planting.
6. Cultivating the crop. 1278.
7. Controlling insects and diseases. 831, 890, 1319, 1329.
8. Keeping and analyzing records. 511, 572, 782, 1182.
9. Harvesting and ginning cotton. 1465. U.S.D.A. Circ. 205.
10. Storing, classing and marketing cotton. 775. U.S.D.A. Bul. 216, 1056, 1392, 1438, 1444, Circ. 407.

Job 1. Determining the Possibilities, Acreage, and Soil for Cotton

Conditions Usually Found.—(1) Many farmers plant more land in cotton than they can care for efficiently. (2) They frequently plant cotton on land that is too

poor to produce the crop profitably. (3) In too many instances, the same land is planted in cotton year after year.

Aims.—(1) Students should learn to grow more cotton on fewer acres. (2) They should understand the value of rotation. (3) They should also know how to select good cotton soil. (4) They should realize that it is important to know how much of the previous crop has been carried over before deciding on the cotton acreage for the next crops.

Problems for Study and Discussion.—(1) How many acres on the home farm are used to produce food and feed for home use?

2. What feeds that local farmers buy could be grown profitably at home?
3. How many acres of cotton can a farmer cultivate efficiently?
4. To what extent is cotton being grown on the best land in your community? On the home farm?
5. What has proved to be the most satisfactory rotation in your community?
6. What are the characteristics of a good rotation?
7. How does the local cost of producing cotton compare with the costs shown in Table 1? In which group is your home farm?
8. What is the season of heaviest rainfall in your locality? How does it affect the production of cotton?
9. How deep is the top soil on the farms in your community? Is it deep enough to allow the root system of the cotton plant to develop normally?
10. How many of the upland fields in your community are terraced? How do the yields of those that are terraced compare with the yields on those that are not terraced?

Cotton Contestant's Creed

(Dallas News Contest)

I BELIEVE

In myself and in my soil.

That when I make my soil rich it will make me rich.

Five acres intensively farmed will produce as much cotton as is generally raised on 20 or 40 acres.

In "more cotton on fewer acres," which releases land for the feed and food crops that make my farm self-sustained.

It is my duty to leave my farm richer for those who come after me.

That I am entrusted with building my land up and not with wearing it out.

In quality cotton, quality corn, quality livestock.

In living at home and making my farm produce my living.

In making cotton a "clean cash surplus" over and above my living.

That the farmer who has full barns and corn cribs and a well-stocked pantry is on the way to independence.

Farming to be one of the most important and noblest of occupations, and that my efforts intelligently directed will bring the same profitable returns as if applied to any other industry.

"More Cotton on Fewer Acres"

Activities.—Tabulate the names of several local growers with the acreage and soil of each and the crop which usually precedes cotton.

More Cotton on Fewer Acres.—In 1926 the farmers of the United States produced 18,618,000 bales of cotton on 47,653,000 acres or an average yield of 186 pounds of lint per acre. The crop sold for around

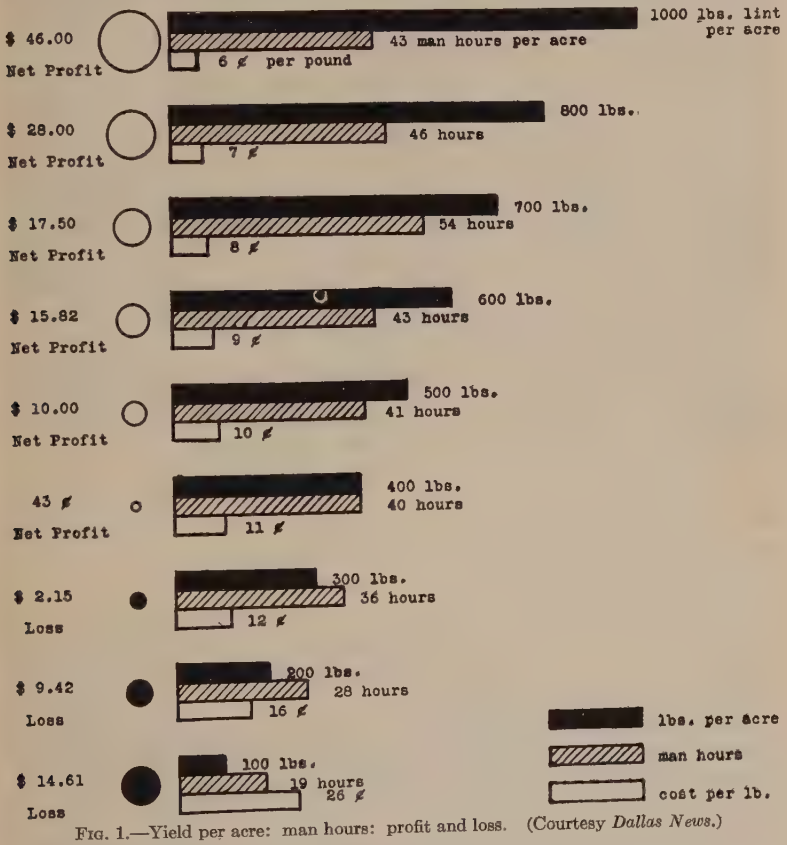


FIG. 1.—Yield per acre: man hours: profit and loss. (Courtesy *Dallas News.*)

eleven cents a pound. It is reasonable to assume that very few of the men who grew this enormous crop made a profit. If the acreage had been one-fourth less, with the average yield the same, it is likely that the price would have been much higher and the profit greater.

In the Dallas News "More Cotton on Fewer Acres" Contest of 1926, the man who produced 400 pounds of lint per acre made a profit of only 43 cents per acre, with cotton selling at eleven cents a pound. (Fig. 1.)

AVERAGE COST OF PRODUCING COTTON ON 1405 FARMS BY YIELD GROUPS, 1925

YIELD GROUP LBS. LINT PER ACRE	AVERAGE YIELD	COST OF PRODUCTION PER ACRE	COST PER LB. LINT	VALUE AT 18¢ PER LB. LINT	NET PROFIT PER ACRE
60 lbs. & under	34	$24.26	$0.71	$ 6.12	— $18.14
61 to 100	89	27.83	.31	16.02	— 11.81
101 to 140	126	26.42	.21	22.68	— 3.74
141 to 180	162	29.71	.18	29.16	— .55
181 to 220	202	31.34	.16	36.36	5.02
221 to 260	246	33.14	.13	44.28	11.14
261 to 300	292	35.85	.12	52.56	16.71
301 to 340	325	38.63	.12	58.50	19.87
341 to 380	360	44.07	.12	64.80	20.73
381 to 420	400	41.33	.10	72.00	30.67
421 to 460	446	49.72	.11	81.28	31.56
461 to 500	496	44.30	.09	89.28	44.98
501 & over	600	46.91	.08	108.00	61.09

In which group would your farm be placed?

Size of Field.—If these studies indicate that comparatively few farmers are making money out of cotton, how many acres should a farmer plant? (Fig. 2.)

Each grower can answer this question intelligently if he takes into consideration the following factors: (1) The number of bales of previous crops yet unused by the spinners; (2) the amount of land needed to produce feed and food for home use; (3) the fertility of his own soil; (4) the number of acres that he can handle efficiently.

1. **Cotton on Hand.**—The grower should find the amount on hand by asking the teacher of vocational agriculture, the county agent, or by writing his farm paper. If the carry-over is large, he should limit his acreage.

2. **Amount of Land Needed to Produce Food and Feed for Home Use.**—The accompanying tables serve as guides in determining the amount of land that should be devoted to growing food for home use, as well as feed for livestock.

3. **The Fertility of Soil.**—Why plant cotton on worn-out land? If the soil is not strong enough to produce at least one-half bale per acre, why plant it in cotton? Our soil is becoming less fertile; consequently the yield is decreasing in many places except where the crop is heavily fertilized. (Fig. 3.)

Shall farmers continue to plant more acres in cotton and buy more commercial fertilizer, or shall they plant fewer acres in cotton and grow other crops to improve the soil? Which is the more profitable? A safe

FIG. 2.—Texas' First King of Cotton, (1924)

John W. McFarlane, Anderson County, Texas, won the first *Dallas News* "More Cotton on Fewer Acres" Contest in 1924 by producing 5081 pounds of lint cotton on five acres. (Courtesy *Dallas News*.)

FIG. 3.—A nice clean stand of cotton field in New Mexico. The soil here is well adapted to cotton. (Courtesy New Mexico Experiment Station.)

FOOD CONSUMED ANNUALLY PER ADULT PERSON BY 250 FARM FAMILIES IN NORTH CAROLINA, GEORGIA, AND TEXAS

Vegetables, including Irish and Sweet Potatoes	13½ bus.
Fruit	3½ bus.
Corn Meal	156 lbs.
Flour	224 lbs.
Syrup	8 gals.
Poultry	57½ lbs.
Butter	45½ lbs.
Buttermilk	97 gals.
Milk	17 gals.
Beef	12 lbs.
Pork and Lard	138 lbs.
Eggs	28½ doz.

FARM MAINTENANCE CROPS

Acres required to grow the food stuffs and feed required for a family of five adult persons, two cows, three hogs, twenty-five hens and two mules. (Ga. Bul. 270)

Crops	Acres
Corn with peas	13½
Oats	4
Wheat	4
Cowpea Hay	8
Cottonseed	6
Permanent Pasture	7
Sweet Potatoes	½
Irish Potatoes	⅓
Vegetables	⅔
Fruit	½

farming program is one that provides for soil-building crops as well as cash crops.

4. **The Number of Acres that the Farmer Can Handle Efficiently.**—This depends upon several factors: (1) Teams and equipment; (2) condition of land, whether clean cultivation has been practised; (3) amount of insect infestation that may be expected; (4) available supply of labor during rush seasons; (5) distribution of rainfall; (6) nature of soil.

Teams and Equipment.—The farmer with one mule and a single plow can cultivate only a few acres. The one with a team and a row cultivator can care for about twice as much. However, the labor supply at thinning and picking seasons should cause the farmer to plant fewer acres than he could take care of with his teams and equipment.

Condition of the Land.—The farmer whose land is foul with grass and weeds cannot hope to cultivate as many acres as the man who keeps his land clean. Or if his fields are rolling and cut up into small units, he cannot cultivate as much as the man with the same equipment whose fields are large and level.

Insect Infestation.—In years of heavy insect infestation, the farmer must spend several dollars an acre in order to have a chance to

make a crop. Through his farm paper, his county agent, or the teacher of vocational agriculture and his own observation, he can secure the information to enable him to estimate fairly accurately the amount of infestation. If the indications are that the infestation is heavy, he may find it advisable to limit his acreage in order to be able to control the insects more effectively.

Available Supply of Labor During Rush Seasons.—Farmers in many sections are finding it increasingly difficult to secure extra labor at thinning and picking times. The labor supply is decidedly a limiting factor to be considered when the crop is being planned.

Distribution of Rainfall.—Excessive rainfall at planting time, or in early fall, may limit the acreage planted in cotton.

FIG. 4.—Joseph Pierce in his three-acre cotton project. Evidently Joseph selected good soil for his crop. (J. K. Coggin, No. Car.)

Nature of Soil.—A soil of such a nature that it packs after every rain, or is hard to plow, requires more time and labor than more favorable soils. This factor should very materially limit the acreage.

Selecting Soil for Cotton.—After the number of acres to be planted in cotton has been determined, it becomes necessary to select the soil that is most suitable for the crop (Fig. 4). Good cotton soil has the following characteristics:

1. It is well drained. Soil that is too wet will not produce cotton profitably.
2. It is strong enough to grow stalks that produce at least one-half bale to the acre under average conditions.
3. It has plenty of organic matter. If this is lacking it can be added

by turning under cover crops such as oats, cowpeas, soybeans, alfalfa, vetch, clover, or other soil-building crops.

4. It is deep enough to allow the root system of the cotton plant to develop normally.

5. It does not drain so rapidly that the top soil is washed away during every heavy rain. If necessary, it is terraced to prevent washing and excessive leaching.

6. It is soil that has not been planted continuously in cotton.

Job 2. Choosing the Type and Variety

Conditions Usually Found.—(1) Several different varieties are grown in the same community. (2) These varieties vary as to yield, length of staple, percentage of lint and quality of lint. (3) Each grower usually chooses a variety without considering what other farmers grow.

Aims.—(1) Growers and members of the class should learn what the characteristics of a good variety are. (2) They should be able to compare the varieties found in the community and select the one that can be grown most profitably.

Problems for Study and Discussion.—(1) What varieties of cotton are grown in the community?

2. What are the characteristics of a good variety?
3. Compare all the varieties grown in the local community, using the answer to question 2 as a guide.
4. Which variety ranks the highest?
5. How does this variety compare with those recommended for the community by your experiment station?
6. Why should or should not other varieties be introduced?
7. How many farmers in the community are growing the variety that the class ranked first? Find out from them why they chose that variety.
8. Why does the spinner object to so much short-staple cotton?
9. What length of staple can the farmer grow and always be assured of a market for his crop?
10. What are the characteristics of an ideal stalk of cotton?

Activities.—Collect sample plants loaded with cotton bolls. Count bolls on plants of different varieties or strains. Study difference in bolls, branching of plants, earliness, storm resistance, and other details.

Types of Cotton.—Length of fibre in cotton influences the price favorably. Sea-island cotton has the longest fibre. It is grown only under coast and island conditions, particularly of Georgia and South Carolina. Upland cotton prevails over the southern states. The lint clings to the seeds and is more difficult to gin. Two types of upland cotton: (a) short-staple, including most of the cotton grown in the central states, with length of ¾ to 1½ inches; (b) long-staple, maturing slowly, slender pointed bolls, less lint, fibre 1¼ to 1⅝ inches (Fig. 5).

Boll-Weevil Conditions.—The coming of the boll-weevil caused a revolution in methods of cotton production. Perhaps the greatest advance has been made in the introduction and development of new varieties to offset the loss caused by the weevil. One of the big problems

of the farmer today is to find the variety that enables him to make the most money.

If he is to choose this variety wisely, he must take the following factors into account: (1) Adaptability to local conditions, (2) earliness, (3) storm-resistant quality, (4) size of bolls, (5) length of staple, (6) ability to resist disease, (7) percentage of lint, and (8) popularity in the community.

Adaptability.—A suitable variety is one that produces the highest yield on the home farm, considering type of soil, amount of rainfall, and fertility of soil.

Earliness.—It must be an early maturing variety. According to U. S. Department circular 200, it must be one that has "the ability to set a good crop of bolls in a short period of time early in the fruiting season. The weevils do not breed until the flower buds are formed, and a month or more must elapse before the weevil population is greatly increased. Hence, it is usually possible for a prolific early variety of cotton to set its bolls before weevils become too numerous and destructive. When all of the flower buds are infested, no more bolls can be set.

"It is only in dry weather that any setting of bolls can be expected later than the first month or six weeks after flowering begins unless the weevils can be controlled by methods of poisoning recently developed. In dry weather the infested buds fall off promptly and are soon shriveled in the hot sun, which kills the weevil larvæ. If the weevils survive the winter in excessive numbers, even the early flower buds may be destroyed, but a crop may be set later if the weevil population is reduced by a period of dry weather, such as sometimes occurs in Texas. Hardy varieties of cotton that can continue to set fruit during dry weather, after weevils have been reduced, are of special value in Texas, now the chief center of cotton production."

Storm Resistant.—It should be a storm-resistant variety. If this character is too highly developed, however, the locks are hard to get out of the burs, which increases the cost of picking.

Size of Bolls.—It must have large bolls. "In Arizona and California in 1920 it cost 4 cents a pound for picking Egyptian cotton because the bolls are small, while upland cotton was picked for 2 cents a pound. In some of the upland varieties, as Lone Star, Holdon, and Tuxtla, a pound of seed cotton may be picked from 50 or 60 bolls, while more than a hundred bolls must be gathered for each pound of Egyptian cotton."

Length of Staple.—A suitable variety is one that has a staple at least one inch in length. The spinners object to short fibers because they do not hold strongly together. "The threads tend to ravel and

come apart, and the fabrics are less durable than those that are made from long staples." (Fig. 6.)

Dr. John A. Todd, noted cotton economics expert from Liverpool, England, said on July 18, 1927, that the spinners are organized to take care of all the one-inch staple that the South can produce.

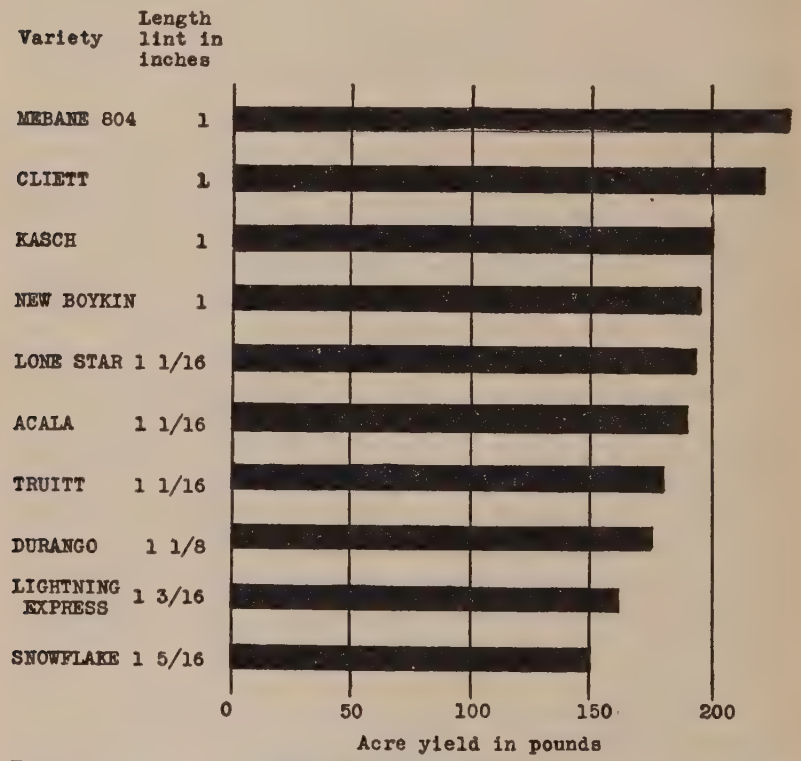


FIG. 5.—Varieties of cotton for the Gulf Coastal Plains of Texas. Comparison of yield of lint and length of lint for the 4 years, 1923–1926 inclusive. (Texas Station Bulletin 354.)

Disease Resistance.—A variety should be chosen that is most resistant to diseases affecting cotton locally. Since state colleges and the United States Department of Agriculture have done notable work in the development of disease-resistant varieties, it is not difficult for the grower to learn just what varieties are most resistant to disease.

Resistant Varieties.—On the basis of recent tests, the Florida Station reports that "Lightning Express No. 3 and Lightning Express No. 4

continue to be the most outstanding among wilt-susceptible varieties and Cook 307–6 among wilt-resistant varieties."

Percentage of Lint.—The variety that produces the highest percentage of lint of a staple at least one inch in length is most desirable.

Popularity in the Community.—If, after all of the foregoing factors have been considered, two or more varieties appear about equally satisfactory, the grower should select of this number the one that is most popular in the community. Growing a single variety of cotton in the community is advisable because (1) the seed can be kept pure with little trouble; (2) the crop will bring a better price since it can be sold in larger amounts of even running staple and grade.

COTTON VARIETY TESTS IN OKLAHOMA

AVERAGES FOR 1918–1924

(Bul. 154)

VARIETY	LENGTH OF LINT	VALUE PER ACRE SEED AND LINT	RANK IN YIELD	RANK IN VALUE
Okla. Triumph 44	1 1/16	$64.45	1	1
Trice	1	56.90	2	2
Acala 5	1 1/16	52.15	8	3
Half-and-half	13/16	51.81	3	4
Bennett's	1 1/16	51.79	5	5
Lone Star	1 1/16	50.90	11	6
Mebane	1	46.87	7	7
Cook's Improved	1	46.60	6	8
King	15/16	45.26	4	9
Express	1 1/8	44.88	9	10
Cleveland Big Boll	15/16	44.00	10	11
Rowden	1	38.11	12	12

COTTON VARIETIES RECOMMENDED FOR ALABAMA

(Circ. 47)

NORTH	CENTRAL (WILT-FREE LAND)	SOUTH (WILT-FREE LAND)
Cook 1010	Cook 1010	Cook 1010
King	Cook 588	Cook 588
Trice	Cleveland-Piedmont	Cleveland-Piedmont
Bottoms	Cleveland-Wanamaker	College No. 1
Acala	College No.1	Toole
	Toole strains	Acala
	Acala	

Long-staple varieties not generally recommended for North Alabama.

Central and South Alabama, on land infected with wilt, Cook 307–6, Resistant strains of Toole, Dixie Triumph, and Dixie Cook.

VARIETY TESTS IN MISSISSIPPI—NINE VARIETIES OF COTTON FOR FIVE YEARS AT THE CENTRAL STATION (FIG. 5)

(Bul. 241)

VARIETY	LENGTH OF LINT	LINT COTTON AV. LBS. PER ACRE	AV. VALUE (DOLLARS)	AV. PER CENT
Half-and-Half	3/4	383.8	$89.89	41.6
Cook	7/8	389.2	94.39	38.8
Cleveland 54	15/16	387.0	100.65	34.9
Cleveland-Wanamaker	13/16	328.2	81.83	37.2
Cleveland-Piedmont	7/8	373.4	96.73	34.4
Lone Star	1 1/16	343.8	95.59	34.0
Trice	1 1/16	360.1	100.48	31.5
Miller	1 1/16	354.2	99.28	34.0
Delfos	1 1/8	345.7	101.23	32.2

GEORGIA STATION TRIALS WITH COTTON VARIETIES

(39th Annual Report)

Varieties		Value of Lint per Acre
Delfos 6102	Long staple	$57.92
Deltatype No. 5		56.43
Super Seven		46.65
Lightning Express	Short staple	46.14
Cook's 588		42.10
College No. 1		41.85

Job 3. Selecting and Testing Seed

Conditions Usually Found.—(1) Gin-run seed is most frequently used for planting. (2) Not much effort is made, except in a few cases, to keep cotton seed pure. (3) Seed is seldom tested or treated. (4) Farmers frequently plant more seed than is necessary to assure a stand. (5) Very few farmers select seed in the field. (6) Many consider this method impracticable for two reasons: (a) requires extra work in the field; (b) too much trouble to get seed ginned separately. (7) Many farmers buy seed from plant breeders and from commercial seed houses.

Aims.—Growers and students should understand: (1) how to recognize ideal planting seed; (2) how to test and treat cotton seed for planting; (3) the advantages of community-variety cotton production; (4) how to select seed in field.

Problems for Study and Discussion.—(1) What are the advantages of community production of seed?

2. What objections to growing only one variety of cotton in your community are raised by some growers?
3. Let each member of the class ask his father and one or more other growers what they consider the benefits to be derived from growing one variety in the community. Tabulate the answers.
4. Draw up a working plan for a pure-seed association for your community. Write to your state commissioner of agriculture or experiment station for a list of pure-seed associations in your state. Write for their plans.
5. Who are the reliable plant breeders in your state? What are the names of the dependable seed houses?

6. How many of these plant breeders produce certified seed? What do they charge for seed? Is the cost too high?
7. What percentage of the cotton seed is mixed at the gin?
8. Why is it so difficult to keep cotton seed pure when several varieties are grown in the same community?
9. Why is the staple of American cotton deteriorating?
10. When is it best for the farmer to grow his own cotton seed? How can he do it?
11. Get opinions of growers and gin operators regarding field selecting of seed.
12. Give directions for field selecting of seed.
13. How many of the farmers in your community test their cotton seed before planting? Ask them if they find it profitable.
14. What are ideal seeds for planting?
15. What evidence have we that cotton seed needs to be tested?
16. What are the causes of low germination?

Activities.—Select seed from the different sources grown in the community and run comparative germination tests on them. Which lot shows the highest percentage? Practise field selecting of seed.

Better Seed.—"Of the 500,000 tons of seed required to plant the American cotton crop, fully 90 per cent is of mixed gin-run quality." (U. S. Yearbook.) No very great amount of improvement can be made in the quality of the South's major crop so long as only 10 per cent of the planting seed can be considered satisfactory. In the article cited above the statement is made that as the production of inferior-quality cotton has increased, the production of superior-quality cotton has decreased to the extent that manufacturers are finding it difficult to get enough good-quality, long-staple cotton.

Improved cotton seed may be secured in three ways:

1. By community production of seed from one variety.
2. By individual purchase from seed breeders or pure-seed associations.
3. Through breeding and selection work on the home farm.

Community Production of Improved Seed.—Production of improved seed through the growing of one high-class variety by the entire community is neither impossible nor impracticable. This method has the following advantages:

1. The use of gin-run seed is avoided. "Experiments with a modern gin plant have shown that more than 25 per cent of the mixture may result in the seed of the first bale that follows a different kind of cotton." (F. B. 1384.) Mixture may occur even in the fourth bale.

2. Cleaning the gin stands and not using the conveyers, to avoid mixing seed, cannot be practised because these precautions require too much time. The necessity for doing this is avoided in a one-variety community.

3. Seeds are easily kept pure because there is no mixing of varieties at the gin or in the field. Although different varieties of cotton are not cross-pollinated by wind-blown pollen, they may be mixed by insects carrying pollen from one field to another.

4. Community-grown seed is cheaper. Seed breeders frequently

charge as much as three dollars per bushel for seed. In communities where one variety is grown, farmers can produce seed for much less than three dollars per bushel.

5. In one-variety communities an ample supply of good seed is always assured. Farmers cannot always be sure of getting a sufficient amount of good seed from reliable breeders. "It is well known that much of the

FIG. 6.—C. T. Valentine, Cotton Contest, Anderson County, Texas, raising 1⅛ inch staple cotton. (Courtesy *Dallas News.*)

commercial seed is not pure, but of ordinary gin-run quality, often no better than the seed that the farmer would get from the local public gin." (F. B. 1384.)

6. Marketing advantages are clearly in favor of the one-variety communities. Buyers will pay more per pound for large quantities of fiber of uniform quality, than they will for fiber from mixed varieties. There are at least two reasons why this is true: (a) Even-running fiber has a

greater textile value; and (b) the labor and expense of classing the cotton is reduced.

Another marketing advantage that the one-variety community may have comes from the fact that buyers compete with each other for large quantities of superior cotton. Dr. John A. Todd of Liverpool, England, is authority for the statement that in India large quantities of good-quality cotton are sold at auction, greatly to the profit of the seller. Similar practices are followed in one-variety communities in America.

7. Cook and Martin (F. B. 1384) estimate that "our present unorganized production of cotton may have only 50 per cent efficiency if measured in returns or profits for the farmer and compared with what might be found possible if improved varieties and methods were regularly used in organized one-variety communities."

Buying Good Seed.—Where different varieties are grown in the community, many farmers buy new seed every two years. If they buy from breeders outside their own community, they should observe the following precautions:

1. Buy only from seed firms or breeders who are known to be absolutely reliable.

2. Buy from a breeder who has developed his variety under conditions most similar to those on the home farm.

3. Buy only certified seed. The cost may be higher but the chances of getting poor seed are almost entirely removed.

4. Buy early and in sufficient quantities to be assured of having enough seed to replant the crop if necessary.

5. Buy seed of a variety that produces a staple of at least one inch in length.

Producing Good Seed at Home.—It is difficult for one man alone to be a successful cotton producer and a successful plant breeder at the same time. In fact, some farmers cannot become skilled plant breeders for the reason that plant breeding is highly scientific work that requires great care, training, and experience. However, there are some things that any farmer can do that greatly improve the quality of seed. He can begin with a good variety and attempt to keep it pure by adopting some or all of the following methods of field selection.

Three Methods of Selecting in Field.—1. Practise field selection by rogueing the crop each year. Pull out all of the off-type stalks. This may seem expensive, but a well-developed variety will produce surprisingly few inferior stalks. To rogue cotton successfully, one must know a good stalk when he sees it and be willing to select rigidly.

2. A second method is to go through the field ahead of the pickers and pick the fully matured bolls of cotton from the best stalks. This

can be ginned at the close of the season without danger of becoming mixed with other seed. However, it is well to keep in mind the fact that seed from the good stalks has most likely been fertilized with pollen from poor stalks growing near by. This greatly lessens the value of the seed.

3. Some farmers select their own seed by picking enough well-selected bolls to plant a patch each year to provide seed for the next year's crop.

Regardless of the method of selection he may use, it is a well-known fact that the farmer who gives intelligent attention to the selection of his seed is always well repaid for his efforts.

Testing Cotton Seed.—"Ideal planting cotton seed may be described as seed selected from cotton that is true to type and pure of variety; well matured; free from disease and insects or insect injury; . . . and with a minimum germination of 88 per cent." (U. S. Dept. Bulletin 1056.)

It is popularly believed that cotton seed does not need to be tested. Tests conducted by the Bureau of Plant Industry show that of the 70 samples tested of a recent crop, the percentage of germination varied from 45 to 96 per cent, averaging 82.5 per cent. Eighty-nine samples of another crop averaged 85.3 per cent germination.

Low germination may be caused by (1) severe drouth during August and September, resulting in immature seed; (2) excessive moisture in bolls; and (3) heating in storage.

Methods of Testing.—There are various ways of testing cotton seed, any one of which is satisfactory. Tests may be made with a rag-doll outfit, with an incubator, or in sand or soil. Care must be taken to prevent excessive heating of the seed. Use at least two lots of one hundred seeds each for the test.

In light of the above figures, it is very evident that there is a real necessity for testing cotton seed. It is further evident that it is neither impractical nor expensive for the average farmer to test cotton seed for planting.

Delinting Seed with Sulfuric Acid.—Many farmers are finding it advisable to delint cotton seed. According to the findings of the South Carolina Station (Bulletin 225), "Seed delinted with sulfuric acid gave earlier stands and greater yields than were obtained from any other seed treatment.

"Method of Treatment.—Concentrated commercial sulfuric acid (66 degrees), two large tubs, wooden stirring paddles and plenty of water are the materials needed in delinting seed with acid. A galvanized tub can be used for delinting and a wooden tub for washing. Where running water is available, a wooden tub with holes bored in the bottom and covered inside with fine-mesh wire is very satisfactory.

"It has been found best not to try to delint too large a quantity of seed at one time, from a bushel to a bushel and a half being the most suitable amount. These are put into the delinting tub and acid poured on them at the rate of nine pounds per bushel for undelinted seed and five pounds per bushel for seed delinted at the oil mill. The seed are then stirred with a paddle until all the lint is removed, at which time the seed are black in color. As soon as the seed are black, water is added and seed stirred. The contents of the delinting tub are then emptied into the washing tub to allow the water and acid to drain. The seed are then washed by running a stream of water on them and stirring until practically free from acid, when they will have only a slightly sour taste. This does not take long if a good stream of water is applied, requiring from five to ten minutes to delint and wash each lot, depending upon the facilities and labor available. When running water is not available, several washings in fresh water should be sufficient to remove the acid. The seed should then be spread on sheets to dry, after which they are ready for planting, or they can be sacked and kept until ready for use.

"**Precautions.**—1. The seed should not be allowed to remain in the acid after all of the lint has been burned off or their vitality will be greatly reduced and may be destroyed.

"2. Care should be exercised not to allow the acid to come in contact with the hands or clothing.

"3. Acid-delinted seed will run through the planter so freely that some adjustment will be necessary to distribute the proper amount of seed per acre at planting time."

More uniform planting is secured after delinting. Much of the thinning or chopping of the young crop is unnecessary. This more than compensates for the cost of delinting seed.

Job 4. Buying and Mixing Fertilizers for Cotton

Conditions Usually Found.—(1) Many farmers are buying commercial fertilizers for cotton when they should be growing soil-building crops. (2) They are not always buying the kinds their soils need. (3) Too few are mixing fertilizers at home.

Aims.—Growers and students should understand: (1) how to determine the kind of fertilizer needed for cotton; (2) in what form to buy; (3) how to home-mix commercial fertilizers; and (4) how much to apply per acre.

Problems for Study and Discussion.—(1) What are the three methods of adding plant food to soil?

2. Work out three-year and four-year rotations for your locality, including cotton and legume crops.
3. What does a farmer need to know before he can select commercial fertilizers intelligently?
4. Let each member of the class ask his father and at least one other farmer the kinds of commercial fertilizer that they use for cotton, and the kind of soil on which they are applied.

5. To what extent are the right kinds of fertilizer being bought? Give reasons for your answer.
6. How can you tell the kind of plant food cotton needs?
7. When should fertilizers for cotton be applied? At what rate per acre?
8. Determine the amount per ton that you or other growers could save on fertilizers by home-mixing them.
9. What is the meaning of a 12–4–4 fertilizer in your state?
10. Why is it important to know the kind of material used to supply the nitrogen in the formula?
11. What is a "unit" of plant food?
12. Which is the more economical, to buy nitrogen or to "grow" it? How do you arrive at your conclusion?

Activities.—Make a collection of fertilizer materials including carriers of nitrogen, phosphoric acid, and potash. Practise mixing fertilizers on a smooth floor and calculate the time required per ton.

Before any farmer can choose fertilizers for cotton intelligently, it is absolutely necessary for him to understand the principal methods of adding plant food to the soil. Not only is this necessary, but he should understand the nature and functions of fertilizers.

The three principal methods of adding plant food to the soil are (1) adding barnyard manure; (2) plowing under soil-improving crops such as cowpeas, vetch, clover, alfalfa, soybeans, oats; (3) applying commercial fertilizers.

Barnyard manure, when properly kept, does two things for the soil: adds plant food and improves the physical condition. The limited supply in the South, however, makes it necessary for us to depend upon two other sources of plant food, soil-building crops and commercial fertilizers.

Growing plant food is cheaper than buying it. A carefully-planned rotation that includes soil-building crops has these advantages:

1. It improves the physical condition of the soil.
2. It adds plant food.
3. It increases the water-holding capacity of the soil.
4. It hinders erosion.
5. It makes possible a better distribution of farm labor.

Selecting Commercial Fertilizers.—Too many farmers buy commercial fertilizers without first considering all of the factors that should guide them in their selection. The grower who expects to make a profit on the use of commercial fertilizers on cotton must be able to answer the following questions. (1) What plant food does cotton need? (2) Which of these plant foods are available in the soil of your farm? (3) How much should be applied? (4) In what combination should the needed plant foods be mixed?

The Plant Foods that Cotton Needs.—Although cotton uses some ten plant-food elements, we know that usually all but three of these are

available in sufficient amounts in the soil. The three most important ones that are lacking in sufficient available quantities are phosphoric acid, nitrogen, and potash.

Deciding which Plant Foods are Available.—There are at least three ways of determining whether or not phosphoric acid, nitrogen, and potash are available in the soil.

1. One way is to watch the effects of these elements on the growth of the cotton plant.

2. A second method is to study the soil map for the region, if one has been made, to see if all three elements are present in sufficient quantities.

3. A third method is to study the records of the fertilizer experiments conducted on the state experiment farms located on the same type of soil as the home farm. If no such records are available, and if no soil maps have been made for the region, the grower should conduct his own experiments to determine what fertilizer elements should be applied to his soil.

Effect of Three Elements on Plant Growth.—A. Phosphoric acid promotes the fruiting of plants, though it is necessary for the development of all parts of the plant.

B. Nitrogen is necessary for the development of all parts of the plant, particularly the leaves; but an excess of nitrogen delays maturity and is likely to promote the growth of stalk and leaves at the expense of the fruit.

C. Potash is present in many heavy soils in sufficient quantity so that its use as a fertilizer is unnecessary. Like nitrogen, it is needed by all parts of the plant, but particularly by the stalk and stems. An excess of potash may also delay maturity and is likely to promote the growth of the stalk and leaves at the expense of the fruit.

When in doubt as to the use of potash, a good plan is to set aside an acre plot and use only phosphoric acid and nitrogen. If the yield is as high on this check plot as it is on like soil where potash is also applied, it is very likely that potash is unnecessary.

How Much Should be Applied? It is best for those not experienced in the use of fertilizers to begin with moderate applications and increase the quantity as experience is gained and fertilizers are found profitable. The amount applied varies from two hundred to as much as six hundred pounds per acre, depending upon the fertility and nature of the soil. (Figs. 7 and 8.) (See Appendix.)

What to Buy.—A farmer may know what plant foods his soil needs and the amount to be applied per acre, but he still has to decide whether to buy his fertilizer ready mixed, or to buy the materials and mix them at home. If he mixes his own fertilizer, he may expect to save money if he buys the right kinds of material and mixes them properly. To do this he must understand the formulas commonly used, and know in what form to buy the elements his land needs. Valuable information along this line can be obtained from experiment stations, as shown by the accompanying tables.

FIG. 7.—Cotton fertilized 600 pounds per acre with 8–3–3 (P–N–K). Yielded 1½ bales per acre. (*Dallas News.*)

FIG. 8.—Checkfield for preceding trial. No fertilizer used. Yield 200 pounds seed cotton. Both photographed July 20. (*Dallas News.*)

Average Composition, Valuation and Selling Price of Different Analyses of Fertilizers

(Texas Bul. 346)

Fertilizer (Formula Order, P-N-F)	Number Cases Averaged	Available Phosphoric Acid Per Cent	Nitrogen Per Cent	Potash Per Cent	Guaranteed Valuation Per Ton	Valuation Pound Per Ton	Selling Price Per Ton
7–5–5	7	8.36	4.64	5.39	$39.40	$39.69	$48.73
8–3–3	24	9.04	2.99	3.42	28.20	29.91	38.91
8–3–5	2	8.89	3.08	4.38	30.60	31.38	39.20
8–4–4	42	8.89	3.79	4.53	34.40	35.17	42.92
8–4–6	41	9.22	3.78	6.05	36.80	37.25	45.30
9–6–3	2	10.08	5.01	3.55	44.40	41.40	52.70
10–2–2	89	10.69	2.11	2.55	24.40	26.45	34.22
10–3–3	111	10.52	2.94	3.44	30.60	31.49	38.69
10–4–0	5	10.38	3.92	.....	32.00	32.08	40.98
10–4–2	60	10.78	3.79	2.85	34.40	35.29	43.44
10–6–7	8	10.35	5.61	6.79	50.40	48.72	56.59
12–0–4	2	13.15	.....	4.23	19.20	20.87	27.70
12–2–2	15	11.97	2.08	2.45	26.80	27.71	36.25
12–3–0	5	12.50	3.05	.....	29.40	30.27	38.17
12–3–3	38	12.18	2.93	3.46	33.00	33.39	40.53
12–4–4	136	12.26	3.87	4.24	39.20	39.11	45.44
15–0–6	4	15.32	.....	6.09	25.20	25.68	32.86
15–4. 11–5	14	15.05	4.18	5.16	44.55	45.20	49.98
18–6–6	4	17.65	5.97	6.29	58.80	61.06	64.35
Acid Phosphate 16%	72	17.22	.....	.....	19.20	20.66	22.47
Acid Phosphate 18%	77	18.59	.....	.....	21.60	22.31	23.55
Acid Phosphate 20%	17	20.36	.....	.....	24.00	24.43	24.90
Kainit 12.4	9	.....	.....	13.09	14.88	15.62	22.00
Kainit 14.5 up	3	.....	.....	15.36	18.16	18.43	22.87
Sulfate of Ammonia	12	.....	20.63	.....	102.83	103.05	75.96
Nitrate of Soda	35	.....	15.28	.....	74.81	76.72	71.54
Muriate of Potash	9	.....	.....	51.44	60.00	61.73	51.57
Other Mixed Fertilizer	25	9.59	3.60	4.26	34.12	34.62	.....
Cottonseed Meal (Nitrogen)	14	.....	6.60	.....	33.28	32.99	30.39
Cottonseed Meal (Complete)	10	2.27	6.97	1.33	36.72	39.16	33.56

Approximate Average Retail Cost of Plant Food in Cents Per Pound
(Texas Bul. 346)

Fertilizer (Formula Order, P-N-K)	Available Phosphoric Acid	Nitrogen	Potash Soluble in Water
Sulfate of Ammonia		18.45	
Muriate of Potash			5.16
Cottonseed Meal (Nitrogen)		22.83	
Cottonseed Meal (complete)	5.48	22.85	5.48
Nitrate of Soda		23.90	
Superphosphate 20%	6.23		
Superphosphate 18%	6.53		
18–6–6	6.56	27.35	6.56
15–4. 11–5	6.73	28.05	6.73
10–6–7	6.74	28.08	6.74
12–4–4	6.95	28.98	6.95
Superphosphate, 16%	7.02		
9–6–3	7.12	29.68	7.12
12–3–3	7.37	30.70	7.37
8–4–6	7.39	30.78	7.39
7–5–5	7.42	30.93	7.42
8–4–4	7.49	31.20	7.49
Kainit 14.5 to 15.5%			7.55
10–4–4	7.57	31.55	7.57
10–3–3	7.58	31.60	7.58
8–3–5	7.69	32.03	7.69
10–4–0	7.69	32.03	
12–3–0	7.79	32.45	
15–0–6	7.82		7.82
12–2–2	8.11	33.80	9.11
8–3–3	8.28	34.50	8.28
10–2–2	8.41	35.05	8.41
12–0–4	8.66		8.66
Kainit 12.4%			8.87

The table shows that the cheapest forms of phosphoric acid are in cottonseed meal, and in superphosphate (acid phosphate). The nitrogen is apparently cheapest in sulfate of ammonia. Potash is lowest in muriate of potash and in cottonseed meal. The table indicates that the plant foods are usually dearest in the ready-mixed formulas.

Costs of Nitrogen.—In a calculation given in Job 6 of the small grain enterprise in this text, it is shown that the cost per pound of nitrogen in the form of nitrate of soda is 20 cents, which is less than that given in the Texas table above. The cost of nitrogen in the form of barnyard manure is only one-fourth as much, being five cents per pound. But the nitrogen is shown in that calculation to cost nothing if produced by the growth of a winter legume crop such as Crimson clover. The cost of seed and labor is balanced by the feed when used as winter pasture.

Table for Finding the Amount of Ingredients to Use in Fertilizer Formulas

(E. A. Miller, Tex.)

The Texas Station in Circular 31 recommends the following eleven standard formulas of cotton fertilizers: (P-N-K), 12-4-4, 12-3-3, 12-3-0, 12-2-2, 12-0-4, 10-4-2, 10-4-0, 8-4-6, 8-4-4, 8-7-0, 7-5-5.

Per Cent in Material	Per Cent Desired in Formula										
	2	3	4	5	6	7	8	9	10	11	12
5	800	1200	1600	2000							
6	667	1000	1333	1667	2000						
7	572	858	1144	1430	1716	2000					
8	500	750	1000	1250	1500	1750	2000				
9	444	667	889	1111	1334	1556	1778	2000			
10	400	600	800	1000	1200	1400	1600	1800	2000		
11	364	546	728	910	1092	1274	1456	1638	1820	2000	
12	333	500	667	833	1000	1167	1334	1500	1666	1833	2000
13	308	462	616	769	924	1077	1232	1384	1538	1692	1844
14	286	430	570	715	860	1000	1143	1286	1430	1570	1715
15	267	400	533	667	800	933	1067	1200	1333	1467	1600
16	250	375	500	625	750	875	1000	1125	1250	1375	1500
17	235	353	470	588	706	824	940	1059	1176	1294	1410
18	222	333	444	556	667	778	889	1000	1111	1222	1333
20	200	300	400	500	600	700	800	900	1000	1100	1200
21	190	285	381	476	571	667	762	857	952	1047	1142
22	182	273	364	455	546	636	727	818	909	1000	1091
23	174	261	348	435	522	609	696	783	870	957	1044
24	166	249	332	422	500	583	666	749	835	917	1000
25	160	240	320	400	480	460	640	720	800	880	960
47	86	127	170	212	253	298	340	383	425	468	511
48	84	125	168	208	250	294	336	375	417	458	500
50	80	120	160	200	240	280	320	360	400	440	480

"In using the table, look in the first vertical column for the percentage of plant food contained in the material to be used, and in the first horizontal column look for the percentage of plant food desired in the formula. Then read to the point where the two lines meet, and the figure at this point represents the amount of the material to be used.

"Example: Wanted, a 12-3-3 (P-N-K) mixture, and suppose the following fertilizers are used: 16 per cent acid phosphate, 15 per cent nitrate of soda and 50 per cent muriate of potash.

"Proceed as follows: As the acid phosphate contains 16 per cent of phosphoric acid find 16 in the vertical column, and as 12 per cent is desired in the formula, follow the horizontal column across to column headed 12. The number 1500 at the intersection indicates the number of pounds of the acid phosphate to be used per ton. In the same way for the nitrate of soda, follow line 15 to column 3 and the 400 at point of intersection is the amount of nitrate of soda required. For the potash follow line 50 in vertical column to column 3, and you will find the number 120 to be the amount of muriate of potash required.

"From this we get the following:

1500 pounds 16% acid phosphate
400 pounds 15% nitrate of soda
120 pounds 50% muriate of potash

2020 pounds of the mixture.

"You will notice that the amount runs 20 pounds above a ton, and you can see from this that high-grade materials are necessary in high-grade fertilizers in order to keep the amount of ingredients within a ton.

"For a low-grade fertilizer such as an 8-2-2 the amounts obtained by using the table would be as follows:

1000 pounds 16% acid phosphate
267 pounds 15% nitrate of soda
80 pounds 50% muriate of potash

1347 pounds of the mixture
653 pounds of filler

2000 pounds, or one ton of an 8-2-2 fertilizer.

"From this it can be seen that a good deal of filler, such as sand, is required in low-grade fertilizers, whereas in the high grades there is practically no filler. Besides, experiments and demonstrations have shown that in nearly every case the best results are obtained from the higher grades."

Cost of Fertilizer.—"The following is a simple method for calculating the cost of mixed fertilizers per acre:

"Multiply price per ton by number of pounds used per acre, then divide by 2000, and the result will be the cost of amount used.

"Example: Price per ton is $37.50 and 350 pounds are to be used per acre.

$37.50 \times 350 = 13125.00$
$13125.00 \div 2000 = 6.56$
6.56 = cost of 300 pounds

"The cost of the number of pounds of each ingredient in a home-mixed fertilizer may be calculated by the same method, and thus the cost per ton can be easily determined."

How and When to Apply Fertilizer.—Usually the fertilizer should be applied at least three inches below the seed at the time of planting. Experience has proved that if the fertilizer is placed in the ground too early, more than three weeks before planting, much of the plant food may be lost through fixation and leaching.

More than one application may be made under the following conditions: (1) When more than 600 pounds to the acre are used; (2) when the cotton plants seem to be suffering from a lack of plant food, particularly nitrogen; (3) if the spring season has been excessively wet, so as to cause considerable leaching; (4) on deep sandy soil where the plant food is likely to leach out.

Suggestions for Use of Fertilizers for Cotton.—On loam soils with clay or sandy subsoils, where 200 to 400 pounds are used, a 12–4–0

or 10–4–2; if over 400 pounds are used, a 10–4–2 or 12–3–3 or 8–4–4 or 12–4–4 should be satisfactory.

Deep sandy soil, such as Norfolk sand, if 200 to 300 pounds are used, needs 12–3–3 or 12–4–4; if 300 to 400 pounds or more are used, needs 12–3–3 or 12–4–4 or 8–4–4.

For land which produces an excessive stalk but does not produce fruit well, chiefly bottom land, an application of 200 to 400 pounds of 16 per cent acid phosphate is recommended.

Fertilizers are uncertain on black waxy soil or other heavy black limestone soil. A legume rotation is needed most of all. For this type of soil, a trial may be made with 200 to 300 pounds of 12–4–0 or 12–4–4 or 100 to 200 pounds nitrate of soda or sulfate of ammonia, or 100 pounds of acid phosphate and 100 pounds nitrate of soda.

Job 5. Preparing Soil and Planting

Conditions Usually Found.—(1) Not enough fall plowing is done in the South. (2) Fall and winter cover crops are not planted on many southern farms. (3) The land is not broken deep enough. (4) Too little attention is given to the preparation of the seed-bed in the spring.

Aims.—(1) Students and growers should know: (1) the value of fall plowing; (2) proper depth to plow home soils; (3) value of cover crops; (4) what cover crops to plant on the home farm; (5) best methods of preparing seed-bed under local conditions.

Problems for Study and Discussion.—(1) What is the value of terracing? When should it be done?

2. Make a study of the farms in your community to see how much of the land is terraced. Which produces the better yield, the terraced or unterraced land?
3. Make a study of the soils in the community to determine the following points: (a) depth of top soil; (b) relative amounts of humus in soils where cover crops are grown and in soils where such crops are not grown; (c) water-holding capacity of two soils mentioned.
4. What cover crops are grown on the home farm? Of what benefits are they?
5. To what extent is fall plowing practised on the farms of this community?
6. How much more cotton per acre is grown by fall plowing than otherwise?
7. How does the nature of the soil affect the depth of plowing?
8. How many farmers that you know practise deep plowing?
9. How many practise listing?
10. What kind of soil is best suited to deep plowing? To listing?
11. What are the advantages of fall plowing? What are the disadvantages?
12. How is a farmer to know the proper depth to break his soil?
13. When should cotton be planted? At what depth?
14. Give ratio of seeding and distance between rows.
15. How do delinting and testing seed affect the ratio of planting?
16. When is the best time to distribute fertilizer for cotton? Why?
17. At what depth should it be placed in the soil? Why?
18. How much should be distributed?
19. Under what conditions should the fertilizer be placed directly below the seed? Why?

Activities.—Plant cotton seed with a machine planter, using ordinary seed and delinted seed in different plots. Compare the stands after germination Compare two plots, one with ridges, the other level.

Plowing the Soil.—After the fields have been selected for the next year's crop, there is much to do before the seed are to be put into the ground. The time to begin preparing the soil for the new crop is in the fall just as soon as the old crops are off the field. But before fall plowing is begun, the old terraces may need to be rebuilt, or new ones made, (Fig. 9) or attention given to the drain ditches. Late weeds along the turn-rows and fences or other vegetation that served as a winter home for insects should be destroyed.

Although deep fall plowing increases the feeding zone of plants, liberates more plant food, conserves moisture, and otherwise improves

Fig. 9.—Vocational agriculture students building terraces. Kennedy, Texas.

the condition of the soil, the most important purposes of plowing at this time are to make possible the planting of soil-building crops and to destroy the winter quarters for insects.

Fall plowing may be objectionable in three situations: (1) where there is a combination of light soil known as "blow sand" and high winds; (2) where the land is so uneven that it washes excessively; and (3) where the soil is so light that much of the plant food would be leached out during the time of fall and winter rains. These objections, however, may all be overcome by use of cover crops.

Depth of Plowing.—Experiments conducted by the various state stations indicate that plowing to a depth of five to seven inches produces the best returns. Plowing at greater depths may increase yields over those obtained from the five- to seven-inch depth, but not enough to justify the increased cost. These depths vary materially with the nature of the soil.

Preparing the Seed-Bed.—Before the seed-bed can be prepared in the spring, the cover must be turned under. This may be done in one of three ways: breaking, disking, or bedding. The methods of preparing the seed-bed to be used depend upon the amount of time the farmer has, the amount of rainfall, the kind of cover crop to be turned under, and whether the seed are to be planted in the furrow, on the ridge, or on the level. The character of the soil is sometimes a governing factor in deciding the method to be followed in the preparation of the seed-bed. Flat breaking or turning suits soils which warm up early and where soils are likely to dry out rapidly. Disking before turning the soil in spring allows work to begin earlier.

Ridge Planting.—If the region is one having rather heavy spring rainfall, the soil should be bedded and the crop started on ridges. (Fig. 10.) This has two advantages over planting on the level or in the furrow: it keeps the seed from being drowned by heavy rains; it permits the seed-bed to warm up more rapidly in the spring.

FIG. 10.—Planting four rows of cotton at one time. Black land belt, near Corpus Christi, Texas. (Courtesy *Progressive Farmer*, Texas Edition.)

Furrow Planting.—If the region is one of low rainfall, the soil should be bedded and the seed planted in the water furrow. This method theoretically gives the growing plant the advantage of more of the moisture than planting the seed on the level or on the ridge. The furrow method is growing less popular because the total evaporation from ridged land is greater.

Level Planting.—Many large plantations practise level planting. This saves the cost of ridging or furrowing the field. It allows cross-harrowing of the field before and after germination. In this plan the soil is thoroughly harrowed several times before planting. Weed seeds are destroyed by the germination process. The soil is warmed by allowing the percolation of water each time it is harrowed.

Time of Planting.—The time of planting cotton is determined by the frost dates and the condition of the soil. If the danger of frost is past, and if the soil is warm, the seed may be planted without much danger of rotting. (See tables.) The crop should be started as early as soil and weather will allow, to get ahead of boll weevils.

The accompanying tables of planting dates and frost dates may be of assistance to farmers and students in determining the safest time to plant cotton.

USUAL TIME FOR PLANTING, BLOOMING, AND PICKING OF COTTON, BY STATES

(Griffith's Cotton Yearbook)

The dates and periods given in the accompanying table were compiled from replies to inquiries in most cases from officials of state agricultural departments or from experiment stations.

STATE	USUAL PLANTING TIME	AVERAGE NUMBER OF DAYS		USUAL TIME TO BEGIN PICKING
		Planting to First Bloom	First Bloom to First Open Boll	
Alabama N.	Apr. 26	60	45	Sept. 7
Alabama S.	Apr. 12	60	45	Aug. 18
Arkansas N.	Apr. 25–May 10	60–70[1]	60–45[1]	Sept. 1
Arkansas S.	Apr. 15–25	60–70[1]	60–45[1]	Aug. 15
Arizona	Mar. 15–Apr. 1	60–100	70–100	Sept. 15
Cal.—San J. Val.	Apr. 1–May 15	75–80	45–55	September
Cal. extreme S.	Mar. 15–June 1	75–80	45–55	September
Florida	Mar. 15–Apr. 15	80	75	Aug. 15
Georgia N.[2]	Apr. 15–May 1	70	60	Sept. 10
Georgia S.[3]	Mar. 15–Apr. 5	75	65	Aug. 5
Louisiana N.	Apr. 10–25	70–80	35–45	Aug. 25–Sept. 5
Louisiana S.	Apr. 1–15	70–80	35–45	Aug. 15–25
Mississippi N.	Apr. 25–May 1	60–70	35–45	Sept. 1–15
Mississippi S.	Apr. 1–10	60–70	35–45	Aug. 10–20
Missouri[4]	Apr. 25–May 15	70	45	Sept. 15
N. Carolina N. E.	May 1	70	55	Oct. 1
N. Carolina S. E.	Apr. 20	70	50	Sept. 15
Oklahoma N.	May 10	40–45	45–50	Sept. 15
Oklahoma S.	Apr. 25	40–45	45–50	Aug. 25
S. Carolina N[4]	Apr. 20	70	50	Sept. 15
S. Carolina S[4]	Apr. 25	70	60	Sept. 5-10
Tennessee[5]	Apr. 25–May 5	75	60	Sept. 1
Texas N. W.	May 1–15	58	44	Sept. 15
Texas N.	Apr. 20–May 5	60	44	Aug. 25
Texas Central	Apr. 5–May 1	60	40	Aug. 20
Texas S.	Mar. 1–15	65	42	Aug. 1–15
Virginia S.	Apr. 25–May 15	60–65	40–50	Sept. 10–15

[1] Wet, cool weather retards; dry advances. [2] Data furnished by Atlanta Commercial Exchange. [3] Data furnished by Savannah Cotton Exchange. [4] Approximate estimates. [5] No experimental data on periods.

FALL AND SPRING FROST DATES IN COTTON GROWING STATES

(Griffith's Cotton Yearbook.)

STATES	USUAL LAST IN SPRING	USUAL FIRST IN AUTUMN	EXTREME DATES (RECORD FOR MANY YEARS)	
			Last in Spring	First in Autumn
Ala. Upper	Mar. 31	Nov. 2	Apr. 25–'10	Sept. 27–'99
Lower	Mar. 10	Nov. 11	Apr. 5–81	Oct. 21–91
Ark. Upper	Mar. 21	Nov. 5	Apr. 17–21	Oct. 9–17
Lower	Mar. 27	Nov. 4	Apr. 25–10	Oct. 11–06
Fla. Upper	Feb. 16	Dec. 6	Apr. 10–16	Nov. 12–92
Lower				
Ga. Upper	Apr. 2	Nov. 1	Apr. 21–14	Oct. 11–06
Lower	Mar. 23	Nov. 9	Apr. 26–10	Oct. 11–06
La. Upper	Mar. 6	Nov. 10	Apr. 9–16	Oct. 20–91
Lower	Feb. 20	Nov. 18	Apr. 5–91	Oct. 14–07
Miss. Upper	Mar. 25	Oct. 31	Apr. 26–10	Oct. 13–17
Lower	Mar. 14	Nov. 14	Apr. 25–10	Oct. 20–17
N. Car. Upper	Apr. 7	Nov. 2	Apr. 24–06	Oct. 10–95
Lower	Mar. 10	Dec. 5	Apr. 15–07	Nov. 2–13
Okla. Upper	Mar. 22	Nov. 3	Apr. 21–18	Oct. 10–06
Central	Mar. 31	Nov. 2	Apr. 30–03	Oct. 7–91
S. Car. Upper	Apr. 3	Nov. 2	Apr. 24–03	Oct. 10–15
Lower	Mar. 18	Nov. 18	Apr. 17–05	Oct. 30–10
Tenn. Upper	Apr. 2	Oct. 27	Apr. 24–93	Oct. 8–89
Lower	Mar. 22	Nov. 3	Apr. 25–10	Oct. 2–76
Tex. N.	Apr. 17	Oct. 29	May 23–92	Sept. 22–12
East	Mar. 19	Nov. 13	May 1–03	Oct. 8–91
S.	Feb. 24	Nov. 28	Apr. 5–20	Oct. 30–17
Cen.	Mar. 21	Nov. 10	Apr. 23–07	Oct. 19–17

Distributing Fertilizers.—Commercial fertilizers may be distributed as much as three weeks before planting, or at time of planting. If they are distributed at time of planting, they should be placed in the furrow three inches below the seed, and well scattered. If the fertilizer is not well distributed, the roots of the plants will not spread themselves widely enough to secure plenty of moisture during dry seasons. Roots should spread in search of both plant food and soil moisture.

Rate and Depth of Planting.—It is usual for farmers to plant from three-fourths to two bushels of seed per acre. Perhaps a majority of growers plant about one bushel. Although many of the plants that come up must be thinned out, it is a good policy to plant more seed than is needed for the reasons that (1) some of the seed may have low germinating power, (2) some may rot as a result of too much rainfall, and (3) a thick stand is favored under insect conditions.

Effects of Delinting and Testing Seed.—When good seed is used the stand of plants will be more uniform. Delinted seed drops more

evenly through the planter boxes. Seed that has been tested and shows good vitality will make a better and more even stand. The saving in the amounts of seed used pays for testing and delinting seed.

Spacing.—Under boll weevil conditions rows are planted closer together than otherwise. The distances between rows usually vary from 3½ to 4 feet. In some regions plants are placed singly at distances from 9 to 18 inches in the row. In other regions some varieties are spaced two or three plants in a place at distances from 18 to 36 inches along the rows.

Job 6. Cultivating the Crop

Conditions Usually Found.—(1) Farmers do not all know how many times they should cultivate their cotton. (2) Methods in use are not always efficient. (3) Too much time is spent on thinning.

Aims.—The most economical methods of cultivating the crop should be understood and practised.

Problems for Study and Discussion.—(1) How is a farmer to know the number of times he should cultivate his crop?

2. How much time do farmers spend per acre on thinning cotton?
3. To what extent do they find it profitable to cross-harrow the crop?
4. How much does cross-harrowing or cross-cultivating reduce the cost of other cultivation and of thinning?
5. How close should the stalks be left in the row?
6. How does the practice in the community compare with the recommendations made by Cook?
7. How does spacing of plants in rows in your community compare with the recommendations in the accompanying table.

Activities.—The members who have cotton projects might leave the stand on a quarter of an acre much thicker than the rest, and study the results. They should be careful to select soil for the test that has no especial advantage over the remainder.

To study frequency of cultivation, each student pursuing a cotton project may select an acre near the middle of his crop, and leave it uncultivated except for the removal of weeds and grass. Cultivate the remaining acres as many times as seems best. At picking time compare the yield on this uncultivated acre with the yield on other acres to see which has produced the greater net profit.

Cotton is cultivated for two reasons: to destroy grass and weeds, and to conserve moisture. Decisions have to be made as to the frequency and depth of tillage as well as to thinning and spacing of plants. (Fig. 11.)

Frequency.—There is no rule for determining the number of cultivations. The eleven leading contestants in a cotton-growing contest, held by the *Dallas News*, cultivated from 6 to 24 times.

The Georgia Station gave data for one season only regarding the yields of seed cotton per acre as influenced by number of cultivations as

follows: (a) no cultivation, but weeds removed, 1681 pounds; (b) ordinary cultivation, 1657 pounds; (c) cultivated every week, 1665 pounds.

At the present time, the general practice is to cultivate (1) following a rain soon after planting to prevent the formation of a dense crust that would hinder young plants coming through; (2) just before thinning;

FIG. 11.—Cultivating six rows at one time. Black land belt near Corpus Christi, Texas. (Courtesy *Progressive Farmer*, Texas Edition.)

(3) after chopping or thinning; (4) following each rain that is heavy enough to form a crust; (5) at other times as often as necessary to keep down grass and weeds. (Fig. 12.)

Depth.—The proper depth for cultivating cotton depends upon the stage of the crop. The first cultivation, with a light harrow or scratcher,

FIG. 12.—This Vocational boy grew six bales of lint cotton on three acres and won the state prize in cotton-growing. "May his tribe increase." (E. B. Matthew.)

should be shallow. The second and third cultivations may be deep or shallow, according to conditions as judged by the farmer. Later cultivations, about 1½ to 2 inches deep, must be shallow to prevent injury to the feeding roots of cotton plants. However, late in the season it may be advisable to cultivate rather deep if the plants are growing too rank and are

not setting much fruit. This checks the growth of the vegetative parts of plants and fruiting may result.

Thinning cotton is an expensive operation with hand labor. Much of this can be saved by planting seed that is tested and delinted.

Much is also eliminated in some sections of the cotton belt, where planting is on the level, by means of cross-cultivation at the usual time of thinning. In the Corpus Christi, Texas, area farmers attach to the rear of a cultivator a 6-foot cross-beam to which small sweeps have been fastened at intervals of 12 inches. This method enables one man to thin 8 to 10 acres per day with a one-row cultivator. This experimental method seems to offer an inexpensive way of reducing the cost of thinning cotton. Cross-harrowing may also reduce the work.

Spacing.—Experiments to determine the effect of spacing upon yields indicate that close spacing is desirable. Recommendations of nine state stations are given in the accompanying table.

State	Plant Spaces in Row, Inches	State	Plant Spaces in Row, Inches
Alabama	12–18	Tennessee	6–18
Arkansas	8–10	Texas, east	9–12
Florida	18 (2 stalks) 12 (1 stalk)	Texas, Beeville	21
Georgia	12–18 (rich land)	Texas, Troup	30
Miss., central	6–12	Texas, Angleton	12
Miss., Delta	8	Texas, Temple	21 (2 stalks)
Miss., north	12 (2–3 stalks)	Texas, Spur	12
Miss., south	close	Texas, Lubbock	12–15
N. Carolina	12	Tex., Nacogdoches.	27 (2–3 stalks)
S. Carolina	7–9	Tex., Chillicothe	30

Some advantages of thick spacing are clearly set forth in the following quotation from O. F. Cook of the U. S. Department of Agriculture:

"In addition to planting early varieties, cultural precautions need to be observed in the interest of small size and early maturity of the plants. Even the earliest and most prolific varieties, if forced into rank, luxuriant growth, may grow into large late-maturing plants and yield only small crops. The advantage of small plants is not limited to weevil-infested districts or even to short-season conditions. The rule is that small upright plants, close together in the rows, are better than large spreading plants for purposes of production. Very large crops can be raised on relatively small plants, not more than 3 feet high with upland cotton or 4 feet high with Egyptian cotton. Larger growth of the plants does not promise a larger yield, but is more likely to reduce the yield, through

blasting and shedding of buds and young bolls. Plants that are too large and luxuriant may fail to set any bolls or may put on a late crop of bolls, to be destroyed by an early frost. Crowding between the rows, as in fields of large, spreading plants, shuts out the light and interferes with the development of an early crop, which must be borne near the ground on the lower fruiting branches of the main stalk of the plant, not on branches that develop late in the season.

"Vegetative branches are more numerous on large plants and often replace the lower fruiting branches. Usually the vegetative branches are confined to the lowest joints of the main stalk, below the sixth or seventh joint, while fruiting branches usually begin at the seventh, eighth, or ninth joint, though sometimes not till the twelfth joint, or above. In extreme cases of luxuriance all of the fruiting branches may be replaced by vegetative branches, and the plants produce no fruit, though growing to enormous size.

"As a means of securing early crops of cotton in the presence of the boll weevil or in short seasons, it is better cultural practice to have large numbers of small plants than small numbers of large plants. Vegetative branches are not desirable for purposes of production. After the structure of the plant was studied and the two kinds of branches were recognized as distinct, it became possible to devise very simple and effective methods of suppressing the vegetative branches by keeping the young plants closer together. With deferred thinning and close spacing in the rows most of the plants develop with a single upright stalk. With rows 36 to 42 inches apart the largest crops are produced from single-stalk plants less than a foot apart in the row, not from wide-spreading plants 2 or 3 feet apart. The single-stalk system avoids crowding between the rows and secures a more normal development of the lower fruiting branches, where the early bolls are produced."

Job 7. Controlling Insects and Diseases

Conditions Usually Found.—(1) Farmers are compelled to fight boll weevils, flea hoppers, and other insects in order to make a crop of cotton. (2) Most of them have learned how to combat these insects rather effectively.

Aims.—How to recognize the insects and diseases that attack cotton crops, and how to fight these enemies, should be understood by growers and students.

Problems for Study and Discussion.—(1) What is the estimated annual loss from boll weevils?

2. Explain how a knowledge of the life history of the weevil has helped in working out effective methods of control.
3. Why is the dusting method effective and economical as a measure for controlling boll weevils?
4. Calculate the cost of making four applications of calcium arsenate by the dusting method. Use local prices.
5. What is the objection to picking up squares as a preventive measure for fighting the boll weevil?

6. To what extent is the flea hopper a menace to cotton in your community?
7. What methods of checking the damage are used locally? Are they effective?
8. How does flea-hopper damage differ from boll-weevil damage?
9. Describe the appearance of the flea hopper and its work.
10. What cultural methods help to control this insect?
11. Make a list of other insects that damage cotton in your community.
12. State the most effective ways of checking their work.
13. What cotton diseases affect cotton locally? Are they being controlled?
14. Give the best methods of control for each disease.

Activities.—Collect specimens for study and to be preserved in 5 per cent formalin. Include insects and diseases and their work.

Fig. 13 Fig. 14

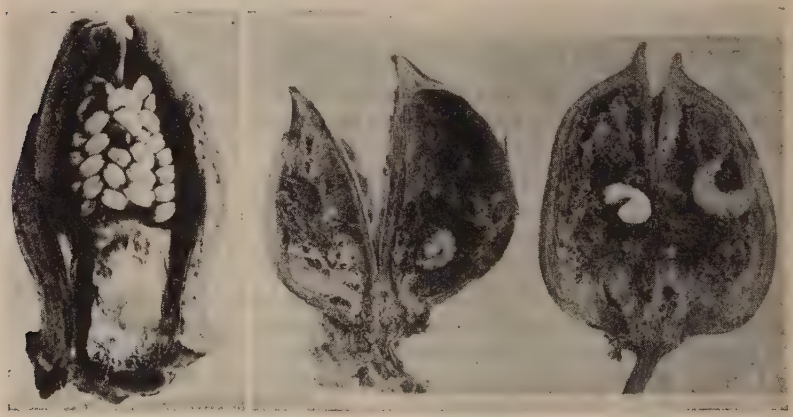


Fig. 13.—Boll Weevil egg among anthers on square. (Texas Station.)
Fig. 14.—Boll Weevil larvæ in bolls. (Texas Station.)

The U. S. Department of Agriculture estimates that for the last several years the average annual loss to the cotton farmers of the South from boll-weevil infestation was more than $3,000,000. When we add to this the loss from boll worm, leaf worm, flea hopper, wilt, root rot, and other enemies, we realize that the growers of cotton must adopt not only the best methods of control, but also the most successful methods of soil preparation, cultivation, and marketing if they are to produce cotton at a profit.

Fig. 15.—Adult boll weevil. (Enlarged) (Texas Station.)

The Boll Weevil.—The four stages in the life history of the weevil are (1) the egg; (2) the larva or grub, which is the growing stage; (3) the pupa or changing stage; (4) the adult or true beetle. The egg hatches in three or four days; the larva develops in six to twelve

days; the pupa in three to five days. All of this means that the egg laid today may be an adult and beginning to lay in fewer than twenty days. A knowledge of these facts has made it possible to work out rather effective methods of control. (Figs. 13, 14, and 15.)

FIG. 16

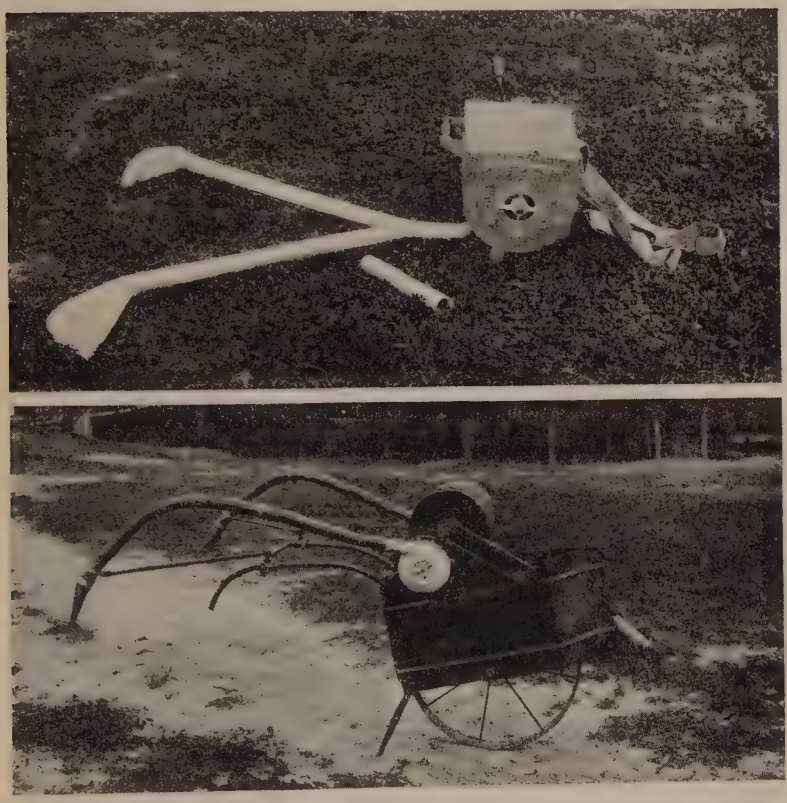


FIG. 17

FIG. 16.—Niagara hand duster. (Texas Station.)
FIG. 17.—Two-row traction duster. (Texas Station.)

Controlling Weevils. Mopping Young Plants.—Two methods of controlling the boll weevil are now generally in use. One method requires a mixture of one pound of calcium arsenate, one gallon of cheap molasses, and one gallon of water, applied to the tops of the plants with a mop. The rate is usually one gallon to the acre. This method is most effective before the squares form.

FIG. 18.—Dusting cotton field with calcium arsenate to control boll weevils. Results in this trial were very satisfactory. In one morning 1400 acres were well dusted before the dew was gone. This was on a large-unit ranch in Texas. (Huff Deland Dusters, Inc.)

FIG. 19.—Ross Hollingsworth, vocational agriculture student, Denison, Texas. Winner of the first prize in the Texas Safe Farming contest (essay). He is shown dusting his cotton project.

Dusting with Calcium Arsenate.—The most successful method of control is the one developed by B. R. Coad and recommended by the U. S. Department of Agriculture.

Use only strong calcium arsenate in the form of dry powder. Apply this only in dust form. (Figs. 16 and 17.) This must conform to the following specifications: Not less than 40 per cent arsenic pentoxid; not more than 0.75 per cent water-soluble arsenic pentoxid; density not less

Fig. 20.—Punctures made by boll weevils feeding. (Texas Station.)

than 80 nor more than 100 cubic inches per pound. (Samples sent to Delta Laboratory, Tallulah, La., will be analyzed free.)

Use only dusting machinery made for cotton dusting. (Fig. 18.) Poison only when the air is calm and plants are moist. (Fig. 19.) This usually means night applications. Use about five to seven pounds of calcium arsenate per acre for each application. Start poisoning when the weevils have punctured from 10 to 15 per cent of the squares. (Fig. 20.) Usually about three applications, one every four days, is sufficient. Then stop poisoning till weevils again become numerous. If weevils again become abundant and are harming young bolls dust once or twice more

late in the season. If there is a heavy rain within twenty-four hours after applying poison, repeat the operation immediately.

It is well to keep this fact in mind: *It is a waste of time and money to dust cotton which does not promise a yield of at least half a bale of lint an acre.*

FIG. 21.—A home-made, two-row, bag dusting outfit for "pre-square" dusting only. (W. E. Hinds, Louisiana.)

Farm Practices Control Weevils.—The cotton farmer may simplify the problem of controlling weevils by adopting the following practices recommended by the U. S. Department of Agriculture and state stations.

1. Select an early maturing variety.
2. Destroy hibernation quarters.

FIG. 22.—This boy is protecting his cotton project against insects. He sprays four rows at a time, covering as much as ten acres in one day with this outfit. Operated from the back end of the wagon. (E. B. Matthew.)

3. Practise clean cultivation.
4. Fertilize to hasten maturity.
5. Destroy stalks early in fall.

6. Plant as early as possible.
7. Warm soils in spring by frequent harrowings.

Poisoning vs. Picking Squares.—Some authorities have recommended picking up squares as a preventive measure. W. E. Hinds, Entomologist, Louisiana, says: "One pre-square poisoning (Fig. 21) is usually as effective for weevil control as three or four collections of infested squares and is much cheaper and less laborious. Furthermore, the pre-square poisoning is likely to delay a week or ten days the time at which ten per cent of the squares will show weevil punctures and thus save one of the regular later applications of poison." (Fig. 22.)

FIG. 23.—Cages used in emergency work for flea hopper. Boll-weevil cages are shown at left. (Texas Sta.)

Flea Hoppers.—Since the flea hopper is a serious enemy of cotton, considerable space is given to a discussion of this insect and the methods of control recommended by the Texas Station. (Circular 40.) (Fig. 23.)

"Injury to Cotton.—The injury to the cotton plant resulting from cotton-flea-hopper attack is characterized by an excessive blasting and shedding of very small squares (Fig. 24), a reduction in the number of fruiting branches, and a tall whip-like growth of the main stem (Fig. 25), or an increased number of vegetative branches.

"The most severe damage to cotton usually occurs in the early part of the season at the time when squaring normally begins and may continue for a period of several weeks. Under certain conditions, however, the

injured plants apparently recover from the effects of cotton-flea-hopper attack, and begin to set fruit after mid-season. Nearly normal crops have been produced in some localities in fields which in the early season had suffered heavy damage. This may be due to migration of the insects from the cotton to weeds as the cotton matures.

"**Description of the Insect.**—The adult cotton flea hopper measures about one-eighth inch in length. It is oval in outline and pale or yellowish green in color, with very minute black spots on the entire upper surface. When at rest the wings are held in a flat position closely folded over the

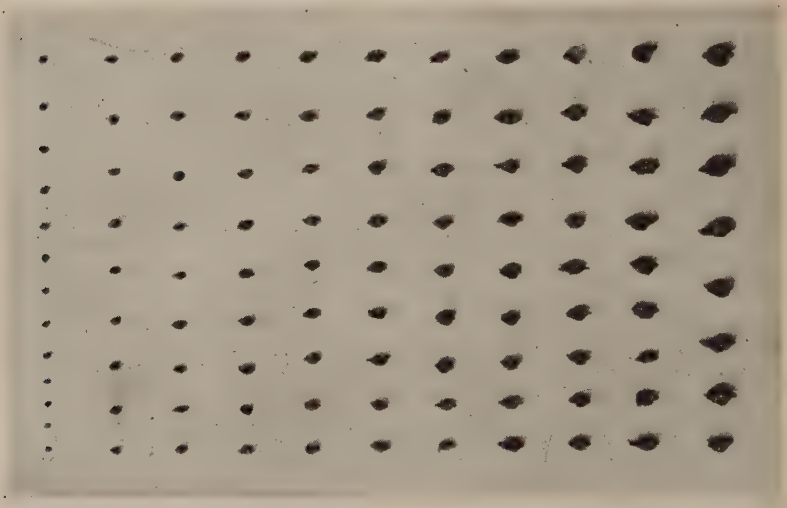


FIG. 24.—Squares that were shed because of injury by the cotton hopper. Note variations in size. (Texas Station.)

abdomen. The adult insect is active and when disturbed usually flies to a plant a short distance away and quickly hides itself beneath a leaf or on the opposite side of the stem from an approaching object.

"The egg is minute, elongate, glistening white in color when first laid, changing to yellowish white before hatching. The eggs are laid singly, usually in or just beneath the bark of the tender growing tips of the plant. They cannot be observed without careful examination after removing the bark of an infested plant.

"The newly hatched insect is very small and can hardly be seen without magnification. It has bright red eyes, long slender legs and soon becomes greenish in color. It is most often found feeding in the bud cluster of the plant. There are five stages of growth in the development of the insect. All of these stages have the same general appearance

as the adult insect, except that the wings are not completely formed and none of the young insects are able to fly. However, they are able to run rapidly and hop to some extent. The color of the young insects is very similar to that of the leaves and it is difficult to find them on the plants unless very careful search is made.

"**Seasonal History and Development.**—During March, when the over-wintering eggs begin to hatch, the young insects feed on practically any succulent weeds, if cotton plants are not available. Because of cool weather at this time of the year, they grow very slowly, requiring six to eight weeks to reach maturity. Soon after maturing they mate, and deposit eggs throughout the entire season until the first frosts occur in the fall, at which time all stages of the insect except the egg are killed by cold weather.

"The entire life cycle from egg to adult may be passed in midsummer in 16 or 17 days. In cooler weather, however, these periods are longer. During May and June, 22 or 23 days are required for complete development.

"There are no distinct broods or generations of insects during the season. It appears that seven or eight complete generations are possible during the time that the insects are active in the field.

"**Cultural Measures.**—There are six important facts which can be used to advantage in controlling this pest:

"1. The insect hibernates or passes the winter in the egg stage within the host plants.

"2. At College Station, Texas, hibernation begins as early as September 1.

"3. The principal winter host plants comprise a number of our common weeds. Wherever goatweed or sageweed occurs it is the preferred host plant. In the Rio Grande Valley a triplex or orach is the most important known winter host plant. In the black-land sections of the State, eggs of the insect have been found during the winter season in wild sunflower.

"4. Cotton stalks remaining in the field are a source of infestation to young cotton the following spring.

FIG. 25.—Cotton stalks showing characteristic growth as result of complete injury by cotton hopper. Note the absence of strong lateral branches and consequent reduction of fruiting branches. The plants are generally taller and all varietal characteristics obliterated. Specimens taken Mount Sylvan, Smith County, Texas, November 1925. (Texas Station.)

"5. Even though cotton and the infested fall weeds are plowed under, enough remnants of these plants may be brought to the surface in the spring when the soil is being prepared for planting to cause at least a scattering infestation in the young cotton when it comes up.

"6. Insects emerging in the spring before cotton is available feed and subsist upon practically any succulent weeds, and later may migrate to young cotton.

"**Controlling Flea Hoppers.**—The following recommendations for controlling the cotton flea hopper by the use of sulfur are based upon the results of control experiments conducted on goatweed or sageweed at College Station and field observations on infested cotton in Nueces, Williamson, Hunt, Ruck and Smith counties of Texas.

"1. Sulfur applied as a dust is an effective insecticide for controlling the cotton flea hopper. Best results are obtained when applications are started early or before squaring begins.

"2. The finer grades of sulfur are best adapted for dusting purposes.

"3. The cheapest and most efficient means of applying sulfur to plants is a good type of dusting machine."

Cotton Leafworm.—The cotton worms usually do not become seriously numerous until the latter part of the growing season. They strip the leaves and often attack the buds and young squares. They are often so abundant as to greatly reduce the late crop of cotton. In the southern part of the cotton belt the attacks begin earlier in the season.

Dusting with calcium arsenate as for boll weevil is very effective in protecting the fields from these worms. Two or more applications are sometimes advisable. Farmers should be prepared to apply the poison when the first attacks are noticed.

Cotton Bollworm.—This is the worm known as the corn earworm, the tomato fruitworm, and the tobacco budworm. About August, when corn is no longer young and attractive to these insects, they attack cotton, tomatoes and other plants. The larvæ bore into bolls of cotton and often destroy the later crops.

Poisoning as for boll weevils is the most effective means of protecting the cotton crop from this enemy. The work must be done when the attacks first occur. The bollworms prefer young corn and if several plantings of corn are made near the cotton, it is fairly well protected.

Pink Bollworm.—This enemy makes attacks on cotton bolls similar to the preceding enemy. It is very serious in some seasons in parts of Texas. Poisoning very heavily when attacks are first noticed, has proved effective. Other means of control are being studied.

Good Farming vs. Other Methods.—It can be seen from the foregoing discussion of insects and their control that the kind of control measure to be used is very often influenced by the prevailing prices of

insecticides. In every case it is folly for the farmer to use poor cultural practices and spend large sums of money trying to control cotton insects with artificial measures.

Cotton Diseases.—U. S. Farmers' Bulletin 1187 has a list of the more prevalent cotton diseases with recommendations as to the best methods of control:

Wilt.—Use wilt-resistant varieties. Rotate to reduce root-knot.
Root-knot.—Rotate with immune crops.
Anthracnose.—Select disease-free seed of a resistant variety. Rotate crops.
Bacterial blight.—Select disease-free seed. Rotate crops.
Shedding of bolls.—Conserve soil moisture—by increasing the humus supply; by late shallow cultivation.
Rust.—Add humus to the soil. Use potash fertilizers. Drain wet land.
Texas root-rot.—Plow deeply in the fall. Rotate crops.

Results of Wilt-Resistant Cotton Variety Tests in Mississippi.—Nineteen wilt-resistant varieties of cotton were tested in Mississippi. The table shows the average yield of lint cotton per acre of each variety with yields. The lengths of lint are given.

TESTS OF COTTON VARIETIES FOR WILT RESISTANCE

VARIETY	LENGTH OF LINT	POUNDS PER ACRE		PERCENTAGE LINT	TOTAL DOLLARS PER ACRE	RANK IN VALUE	BOLLS PER LB.
		Seed Cotton	Lint				
Watson	1 3/16	822	259.8	31.6	49.69	1	66
Super Seven	1 1/8	888	291.3	32.8	49.49	2	74
Lightning Express	1 3/16	846	256.3	30.3	49.45	3	74
Dixie Triumph	1	888	293.9	33.1	44.46	4	66
Trice, Miss. Sta.	1 1/16	891	272.6	30.6	43.87	5	77
Cleve., Pied	15/16	903	293.5	32.5	43.62	6	61
Cleve., 54	1	828	278.2	33.6	41.93	7	66
Delfos 6102	1 1/8	771	241.3	31.3	41.42	8	80
Cook, Rhyne	15/16	762	278.1	36.5	39.27	9	62
D. & P. L. No. 5	1 3/16	600	192.0	32.0	38.56	10	67
Toole, Mathis	15/16	741	263.1	35.5	38.28	11	82
D. & P. L. No. 4	1 1/16	669	244.9	36.6	37.83	12	69
Toole, Perry	15/16	753	255.3	33.9	36.68	13	70
Kelly Big Boll	1	660	236.3	35.8	35.68	14	61
Cleve., Humco 20	15/16	657	231.9	35.3	33.00	15	64
Cook, 307-6	7/8	654	228.9	35.0	31.81	16	78
Sol. & Oates Big Boll	1 1/16	531	188.0	35.4	30.03	17	56
Miller	1 1/16	528	178.5	33.8	28.06	18	60
Half & Half, Mahon	7/8	534	205.6	38.5	27.54	19	72

Job 8. Keeping and Analyzing Records

Conditions Usually Found.—(1) Farmers do not keep records of their farm business. (2) Records now in use are too complicated.

Aims.—Students should know (a) how to keep simple records on cotton projects; and (2) how to analyze their records to determine cost of production. (See corn enterprise.)

Activities.—Make forms for record-keeping as in the corn enterprise. Study student project records. Determine the cost of producing a pound of lint cotton for any year. Compare with tables and with community average.

Importance of Records. — Can the American cotton farmer meet threatened competition from India successfully? He does not know for the reason that he has never determined how much it costs him to produce his cotton crop. He will never know until he studies the business of producing cotton more carefully than he has studied it thus far. Simple records must be kept.

SUMMARY OF COSTS OF PRODUCING COTTON, EIGHT AREAS *

	Johnson Co., N. C.	Darlington Co., S. C.	Greene Co., Ga.	Madison Co., Ala.	Madison Co., Miss.	Faulkner Co., Ark.	McIntosh Co., Okla.	Rusk Co., Tex.
No. of farms	54	51	50	52	52	53	52	55
Acres of cotton	846	1,173	746	1,251	2,193	1,275	1,644	1,691
Lbs. lint, acre	436	229	163	110	131	114	93	171
Man labor	$18.67	$14.39	$13.01	$11.24	$17.70	$13.17	$8.31	$9.41
Mule labor	11.09	8.93	9.84	10.11	7.69	7.86	6.18	6.98
Seed [1]	1.08	1.19	1.47	.92	1.61	1.29	.99	.91
Fertilizer [2]	10.89	9.44	5.12	3.54	4.45	3.02	1.40	3.12
Manure	.63	1.26	.54	.35	.24	.62	.15	.11
Sacks, bskts	.05	.08	—	.08	.16	.12	.13	.14
Ginning	4.16	1.98	1.52	.91	1.59	1.32	1.03	2.84
Machinery	1.19	1.27	1.08	1.17	1.27	1.41	.95	1.02
Poison	—	.98	2.62	.77	.23	.64	—	.02
Miscellaneous	.03	.06	.15	.01	.12	—	—	—
Overhead	8.13	6.73	5.58	4.82	5.99	5.11	3.11	4.10
Use of land	10.50	6.00	2.00	4.50	4.50	4.50	3.50	5.50
Gross cost, acre	66.42	52.31	42.93	38.42	45.55	39.06	25.75	34.15
Seed credit, acre	15.45	10.35	6.27	3.75	5.21	4.87	2.71	5.04
Net cost, acre	50.97	41.96	36.66	34.67	40.34	34.19	23.04	29.11
Net cost, lb. lint	.12	.18	.22	.32	.31	.30	.25	.17

[1] Includes replanting seed. [2] Cost based on acres fertilized. * Seven other counties given in "Cost of Producing Cotton in Fifteen Selected Areas, 1923." U. S. Bureau of Agricultural Economics.

Summary and Analysis.—A careful study of the accompanying tables and graphs (Figs. 26 and 27) suggests the kind of analyses to make of annual cotton crop records to find answers to these points:

1. The profit or loss on the farm for one year.
2. Which enterprises showed greatest profits or losses.
3. The unit costs of production, compared with market prices.
4. On what operations money could have been saved.
5. How teams and equipment could be made more productive.
6. Are yields increasing or decreasing each year?
7. Must more fertilizer be used each year?
8. Is enough food and feed produced on the farm?

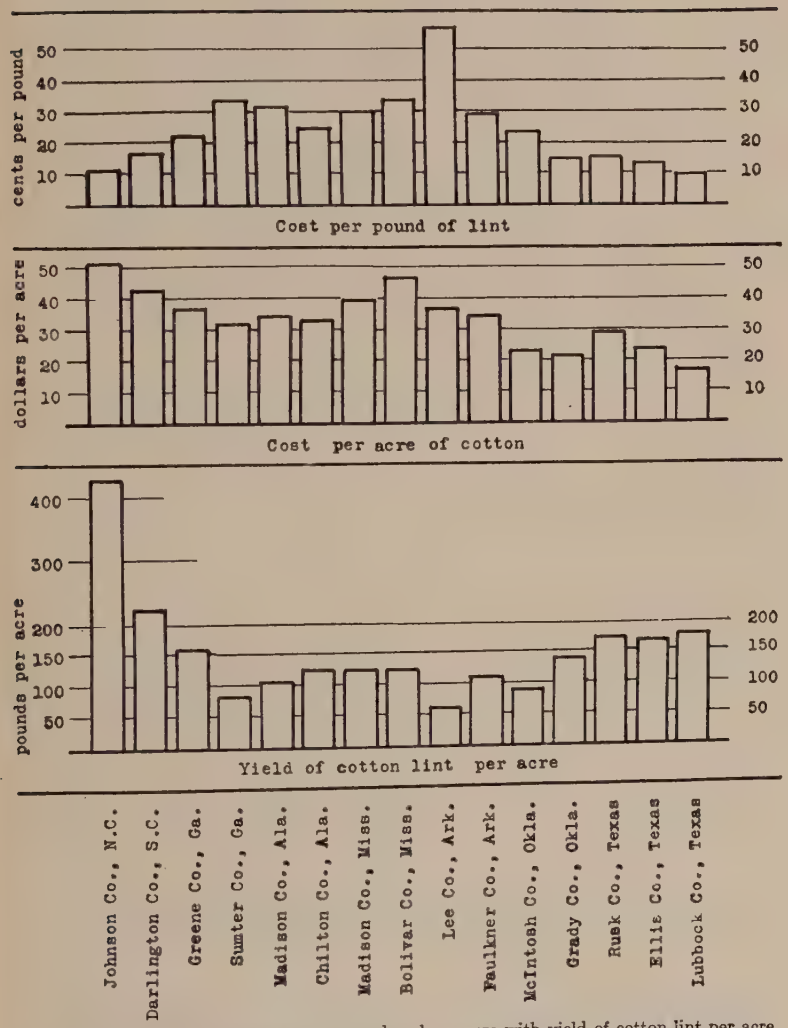


FIG. 26.—Comparison of cost per pound and per acre with yield of cotton lint per acre. The cost per acre tends to rise and the cost per pound tends to fall as the yield increases. These tendencies are most pronounced when comparisons are made for a given crop in a given area.

PRODUCTION COST DATA FOR THE TWENTY LEADING CONTESTANTS IN THE DALLAS NEWS' "MORE COTTON ON FEWER ACRES" CONTEST, 1926

How does this compare with the cost of production on your farm and with data in Job 1?

NAME, KIND OF SOIL s—sandy l—loam c—clay bl—bottom land	POUNDS OF LINT	POUNDS OF SEED	TOTAL INCOME	MAN LABOR COST	HORSE LABOR COST	COST OF SEED	FERTILIZER COST	COST OF MACHINERY AND OVERHEAD	RENT	COST OF PICKING	COST OF GINNING	COST OF MARKETING	NET COST OF PRODUCTION	NET COST PER POUND OF LINT	PROFIT OR LOSS PER ACRE	INCOME PER DOLLAR OF CROP INVESTMENT
F. H. Littleton, s	6,070	11,180	$851.13	$ 8.60	$ 9.00	$11.25	.....	$ 3.64	$50.00	$257.38	$106.36	$10.80	$352.73	$.0581	$77.32	$1.83
Calvin Littleton, s	5,990	7,630	805.88	8.60	9.00	7.50	.....	3.26	50.00	185.94	66.05	9.90	271.45	.0453	91.63	2.32
G. M. Adams, sl	5,825	9,008	799.69	42.40	43.50	26.25	$116.00	25.32	75.00	150.30	62.37	16.50	492.56	.0845	43.41	1.37
Mrs. F. O. Masten, sl	5,719	10,580	802.37	33.00	89.40	5.00	145.01	27.58	50.00	229.19	74.00	15.60	566.38	.0990	26.04	1.19
J. R. Johnston, sl	5,455	7,853	742.95	44.40	36.90	12.50	106.00	21.11	75.00	135.86	57.68	25.00	447.17	.0821	43.45	1.41
C. A. Mebus, bl	5,173	8,484	714.91	59.40	57.00	8.75	.....	13.57	150.00	113.80	76.15	.....	257.37	.0498	45.15	1.46
Mrs. J. W. McFarlane, s	5,131	7,966	704.98	89.60	84.30	7.50	157.75	38.42	50.00	163.75	70.88	13.00	640.54	.1248	3.04	.98
J. Warren (col.), sl	5,090	8,410	704.06	82.00	57.30	12.50	49.00	21.21	37.50	134.94	48.63	26.10	396.33	.0779	44.73	1.47
Anderes Queros, sl	5,053	9,511	710.57	64.80	57.00	10.00	.....	13.88	75.00	154.15	102.44	11.00	400.16	.0792	43.06	1.43
R. T. McCauley, sl	5,002	8,817	697.41	47.60	58.50	10.00	115.00	23.86	25.00	138.70	66.05	45.00	449.04	.0898	42.04	1.30
J. R. Smith, sl	4,973	8,300	688.71	22.60	18.75	10.00	.....	7.91	100.00	146.50	39.77	6.00	296.28	.0596	61.89	1.82
E. J. Kautz, bl, sl	4,805	8,370	668.95	17.00	15.30	12.50	60.00	10.48	62.50	162.13	38.91	40.50	335.62	.0698	49.93	1.60
O. C. Massey, bl, sl	4,585	8,486	643.31	34.80	54.90	13.75	.....	10.50	30.00	195.90	63.00	76.50	395.99	.0864	32.49	1.34
B. Hartsfield, sl	4,221	7,077	584.89	55.40	28.05	8.75	46.10	14.83	37.50	112.98	44.00	40.50	327.34	.0776	37.36	1.47
L. F. Mock, sl	4,208	7,000	582.53	18.40	9.60	1.25	.....	2.93	35.00	151.63	51.85	42.40	243.06	.0576	53.89	1.86
W. H. Jackson (col.), sl	4,130	6,377	566.80	31.80	23.85	15.00	80.50	25.32	25.00	104.99	46.00	26.40	417.09	.1010	17.19	1.18
H. C. Thornton, s	4,088	5,344	551.36	70.60	31.65	30.00	88.75	23.60	75.00	74.24	46.80	26.40	428.60	.1048	13.86	1.14
J. W. McFarlane, s	4,082	6,288	560.07	63.60	42.30	9.38	98.50	25.58	50.00	129.63	50.30	10.40	458.81	.1124	7.68	1.07
T. Williams (col.), c	3,728	6,082	514.89	35.60	31.50	18.75	20.63	10.65	37.50	98.10	46.59	14.70	253.20	.0679	40.17	1.64
W. H. Rasbeary, s	3,726	5,989	513.72	44.00	54.00	18.75	123.00	24.08	17.50	98.83	46.84	.....	368.16	.0988	17.13	1.20

Job 9. Harvesting and Ginning Cotton

Conditions Usually Found.—(1) Farmers spend more money on harvesting the cotton crop than on any other operation. (2) They have not been able to reduce this cost to any great extent. (3) Many of them do not seem to understand what effect the methods of harvesting and ginning have upon the grade of cotton.

Aims.—The most economical methods of harvesting and ginning cotton should be understood. The effects of good methods upon grades should be known.

Problems for Study and Discussion.—(1) What are the three methods of harvesting cotton? Compare them in cost.

2. Which of these are practical for your community?
3. What effects do sledding and pulling have upon the grade of cotton?

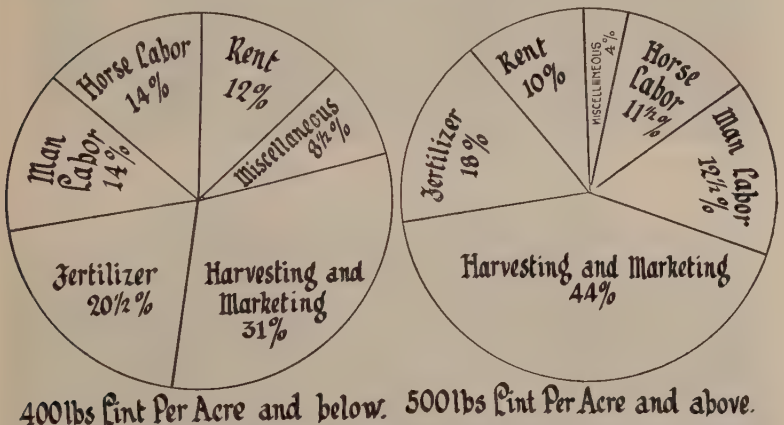


Fig. 27.—Distribution of expenses in raising cotton in the *Dallas News* contest, 1926. The miscellaneous percentage includes seed, poison and machinery. The largest percentage in each case includes picking, ginning and marketing. Better methods of picking are needed. How does the distribution of the cost of production of cotton on your farm compare with this? (*Dallas News.*)

4. Does snapped or pulled cotton have the same spinning qualities that picked cotton has? How do we know?
5. Of what value to a cotton farmer is a knowledge of the preparatory cleaning processes at the gin?
6. How do these processes affect the method of harvesting cotton?
7. What effect does the speed of the gin saw have upon the grade of cotton?

Activities.—Students should visit a gin to study the mechanical processes involved in ginning cotton. Arrangements can be made with the ginner to see just how the speed of the gin saw affects the grade of cotton.

The three methods of harvesting cotton at the present time are: picking, pulling, and sledding. Picking (Fig. 28) and pulling are performed by hand while sledding is done by means of a so-called "sled" as indicated in the accompanying illustrations.

Since picking the cotton is the most expensive operation connected with producing the crop, farmers and farm machinery manufacturing

companies are constantly seeking to devise some way of lowering the cost of this operation. So far, mechanical pickers have not proved to be very

FIG. 28.—State Home vocational agriculture boys, picking cotton in class project, Texas.

FIG. 29.—V- or slot-type cotton sled. As this machine is drawn along the cotton stalks come up through the small slot and the cotton is stripped off. (Garnet Reeves.)

satisfactory. Manufacturers of cotton-gin equipment, however, have made it possible to reduce the cost of harvesting by devising cleaning machinery which removes foreign matter such as leaves, stems, burrs, and

dirt from the cotton before it passes into the saw stands. Since the introduction of these devices, the farmer has been able to harvest his cotton much more rapidly than before.

Sledding.—Harvesting cotton with strippers or sleds is still in the experimental stage. This method has proved to be very popular in Northwest Texas, where it is possible for one man to care for 150 to 200 acres of cotton up to harvesting time. Other factors which have promoted the

Fig 30.—Finger-type cotton sled used in northwest Texas. (Texas Station.)

use of sleds are scarcity of labor, early cold weather, and small stalks. With sleds the crop can be harvested at an approximate cost of two to three dollars a bale. (Figs. 29, 30, 31.)

Snapped and Sledded Cotton.—In answer to the question, what is the effect of pulling and sledding on the grades of cotton, the following is quoted from Texas Bulletin 364.

"The grade of snapped or sledded cotton is on the average one to two grades below the same cotton when picked by hand. The gins on the whole are well

equipped with the most modern machinery including burr extractors and cleaning devices. Marked improvement in cleaning equipment is being made by

FIG. 31

FIG. 32

FIG. 31.—Gathering cotton with the sleds in northwest Texas. (Texas Station.)
FIG. 32.—Burr extractor. Cotton going into machine, coming out below cleaned. At extreme left are the hulls that came from the cotton. (Garnet Reeves.)

the manufacturers of gin machinery, and the grade of the snapped (and sledded) cotton will continue to be improved.

"Spinning tests with snapped and picked cotton have shown that the spin-

ning qualities were practically the same; that there was about five per cent more waste in the snapped cotton but that the percentage of waste was not materially greater than in picked cotton of equal grade.

"It requires approximately two thousand pounds of snapped or sledded cotton to make a bale, leaving about five hundred pounds of burrs at the gin. Analyses of the ash and slag accumulating from the burrs burned for fuel have shown as high as forty-two per cent of potash. At present these burrs are an economic loss and should be returned to the soil. A *burr extractor* (Fig. 32) on the farm either as a separate unit or as a part of the harvester is a possible means of retaining the burrs on the land as well as effecting a saving in ginning cotton. The development and progress made with the cotton harvester, even within this one season and from the crude machines first brought into use in this emergency, was very marked. Vastly greater improvements in types and

FIG. 33.—The gin project grew out of an evening cotton school for adult farmers. The gin cost $35,000, and is owned entirely by farmers (48 stockholders). It is planned eventually to make it a pure-seed gin. The school was conducted by W. N. Elam, teacher of Vocational Agriculture for ten years. (Farmers' Gin Co., Inc. Texas.)

efficiency of the harvester, practices and methods of handling the crop when gathered, and in the cleaning and ginning machinery may well be expected."

Ginning.—Recent improvements in gin machinery have made it possible for the farmer to harvest his cotton more rapidly, as well as to save a greater percentage of the crops. (Fig. 33.) Saving more of the low-grade crop, however, is not wholly beneficial since it competes with better cotton.

Some appreciation of the rapid progress made in the improvement of gin machinery may be gained from the following description of cotton-ginning equipment. (U. S. Farmers' Bulletin 1465.)

"Preparatory Cleaning Processes.—There are a number of bolly or hulling machines, boll extractors, boll breakers, beaters, cleaners, etc., which have for their object the separating of bolls, hulls, trash, and other foreign matter from

the seed cotton before it reaches the gin saws. Some of these machines are separate devices through which the seed cotton is passed before reaching the feeders, others are built as a part of a cleaner feeder, and still others are combined with the separator. Frequently one gin plant makes use of several of these devices, passing the seed cotton through each in turn.

"These devices greatly improve the preparation of both cotton and cotton seed for the market. The removed boll hulls may be used for fuel, thus sometimes effecting a considerable saving.

"Cleaner feeders are sold by every firm that manufactures cotton gins, the different makes being practically the same in mechanical principle. Cleaner feeders should be used by all ginners in preference to plain feeders without cleaner attachments, as by their use the quality of the cotton is improved materially. In the cleaner feeder the cotton passes through fluted rollers and over a rapidly revolving picker roller which is studded with spikes, thus beating the cotton vigorously and dragging it across a heavy wire screen. The greater portion of the dirt and dust drops through this screen and is carried out by a screw conveyor.

"Gin Saws and Ribs.—The designs of the ribs of gins are different for plain, single-rib huller and double-rib huller breasts. Huller breasts have been used more commonly in those sections in which cotton is "gathered" rather than "picked." When cotton is "gathered," bolls, leaves, and trash are mixed with the seed cotton. A huller breast is required to eliminate these, which otherwise would be broken up and remain in the lint. Even in those sections where cotton is picked clean, the opinion is becoming prevalent that a huller breast is a good investment, since years in which the rotting of the bolls causes cotton of lower quality than usual come at uncertain intervals to every section.

"Comparison of 10-inch and 12-inch Saws.—Gin saws are made in two sizes, 10 and 12 inches in diameter. Saws 12 inches in diameter came into more general use with the development of the double-breasted huller gin. They have been found more efficient generally than the 10-inch saws because of their greater wearing surface. They have therefore largely supplanted the smaller size.

"In ginning, the points of the saw teeth penetrate the mass of fibers. Some fibers are caught on the teeth and pulled off the seed. The fibers usually break off close to the seed coat. The fuzz which is left on upland seed after ginning is not the ends of the long fibers, but is composed of a different type of fiber which is naturally short and resembles immature cotton. For good results each tooth should engage only a few fibers, and these should be removed from the teeth before they again come in contact with the unginned cotton. If the seed is damp or the roll too tight or hard, each tooth will take off too many fibers at a time. These may be so many as to be cut when drawn between the ribs, or, if wet, may stick to the saws and be returned through the roll several times, each time taking on more fibers until the lump is cut in passing between the ribs.

"Dull teeth do not penetrate between the fibers readily and are therefore likely to break them. Broken and bent teeth seriously damage the cotton.

Gin saws should therefore be kept sharp and true. In sharpening, care should be taken to see that the original shape or pitch of the teeth is preserved, otherwise instead of sticking into the cotton between the fibers as originally designed their shape may be so changed as to cut the fibers seriously. The edges of the teeth should be smooth. Sharpening usually leaves the edges rough. Unless this roughness is dressed down it is likely to damage the cotton. Newly sharpened teeth will become smooth after two or three bales have been ginned.

"For convenience and saving of time an extra saw cylinder is a good investment. These are interchangeable and should be kept sharp and in good condition at all times so they may be substituted as soon as needed.

"Sand, dirt, stones, and other foreign matter in the seed cotton dull and damage the saws and cause excessive wear in other parts of the gin machinery. Cleaning devices, therefore, not only improve the grade of the cotton but prolong the life and reduce the upkeep of the gin outfit itself.

"Speed of Gin Saws.—Saws 12 inches in diameter have about 20 per cent more edge and teeth than saws 10 inches in diameter; therefore, at the same number of revolutions per minute, the teeth on 12-inch saws are moving farther and faster than the teeth on 10-inch saws. By "saw speed" is meant the speed of the teeth through the seed roll. This speed is limited by several conditions.

(1) The fibers must be removed from the teeth by the brush before the teeth come back into the roll. To do this, it has been found that the brush cylinder must revolve about three times as fast as the saws. Mechanically the speed of the brush is limited.

(2) The speed of the saws is limited by that rate at which the teeth become cutting rather than penetrating and pulling instruments. A disk of writing paper may be revolved fast enough to cut wood. Gin saws if given too great a speed will not only cut the fibers but will also cut seed that may come in contact with the edge of a saw. When seed are cut or damaged, portions of the seed coat, often unginned or with much of the fiber still attached, pass between the ribs and into the lint and reduce the value of the cotton. Excessive saw speed also has a tendency to cut off some of the fuzz, which finds its way into the cotton, increasing the waste and reducing its value for spinning purposes.

(3) The length of fibers also seems to limit the saw speed. The longer the fibers the slower the saws should be run and the softer the roll should be maintained. Probably the longer fibers are more tangled than the shorter fibers, so that a quick jerk will break them before they can slip out of the tangle.

"For ginning cottons up to and including 1 1/16 inches in length of staple, under average conditions, a speed of about 400 revolutions per minute for 10-inch saws and 320 for 12-inch saws is recommended. The capacities of gins equipped with saws of these two diameters are approximately equal at these speeds. Often gins are "speeded up" in an effort to gain time, but the unfortunate result of speeding is to cut the fiber of the cotton to an extent which costs the producers a great amount of money each year.

"Although the undue speeding of gins is discouraged, because of the injury to the fiber, it is realized that a large amount of education will be necessary to overcome the practice. Speeding of gin machinery is not a good economic

principle from a ginner's standpoint. When a piece of machinery is run at a greater speed than was intended by the manufacturer, parts break, boxes run hot, belts slip, and any number of other accidents may happen which, through delays for repairs, will more than offset any advantage gained by a greater speed. The use of 12-inch saws and a reduction in speeds should result in a general improvement in the mechanical operation of the whole ginning plant. These suggestions are offered because it is realized that every reasonable method should be used for increasing capacities without damaging the fiber and that greater speeds are permissible under extraordinary conditions, such as might exist following a long, dry summer or open autumn."

Causes of Low Grade in Cotton.—It is easy to see from this discussion that, in part, low-grade cotton is the result of (1) an excess of foreign matter in the lint, partly due to the method of harvesting; (2) an excess of moisture in the cotton when it is ginned; (3) damaged fiber, due to too rapid speeding of the gin saws; (4) weak fiber, caused by weather damage which occurs while the cotton is in the field or while the bale is left exposed after ginning.

The following table from the U. S. Department of Agriculture, Bulletin 1488, indicates very clearly one reason why farmers of the South are not making money growing cotton. *They are producing too many bales that are of low grade.*

TARE (24 POUNDS IN EACH CASE), VISIBLE WASTE, AND COTTON REMOVED FROM EACH 500 POUND BALE OF THE SEVERAL GRADES

BALE CONTENTS	GRADE								
	1	2	3	4	5	6	7	8	9
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
Waste	26.18	26.13	28.06	29.80	35.65	38.46	49.31	56.45	68.13
Cotton	449.82	449.87	447.20	446.20	440.35	437.54	428.69	419.55	407.25

How many things can the farmer do to improve the grade of his cotton?

Job 10. Storing, Classing, and Marketing Cotton

Conditions Usually Found.—(1) Too many bales of cotton are left exposed to the weather. (2) Many growers hold their cotton under the federal-warehouse plan, borrowing money on the stored cotton. (3) Most farmers sell their cotton through local buyers who sample it wastefully, grade it crudely, and then bid on it. (4) A few sell their cotton through coöperative marketing associations.

Aims.—Students and growers should understand (1) effect of weather damage on cotton; (2) proper methods of storing; (3) how to class and staple cotton; (4) the strong and the weak points of the different methods of marketing cotton; (5) some things about marketing that the cotton farmer must keep in mind.

Problems for Study and Discussion.—(1) Make a list of the methods of storing cotton found in the community. Why is each method used?

2. Calculate the loss to the community from allowing baled cotton to be exposed to weather.
3. Of what benefit is it to a farmer to know the grade of his cotton at the time of selling?
4. What is the purpose of classing cotton?
5. Make a list of the plans of marketing cotton found in the community. Why is each method used?
6. Why is it that there is always a ready market for cotton?
7. Do farmers think the cost of marketing is too high? If so, how can it be reduced?
8. What are the advantages of marketing cotton coöperatively?
9. What are some of the things about marketing cotton that the farmer must keep in mind?

FIG. 34.—Six bales of cotton grown by a vocational student in a three-acre project, Wilson, Ark. (F. T. Mitchell, Ark.)

Activities.—Make a graph showing the prices of cotton by months from a recent Yearbook. How are the prices affected by the sales by months? Practise classing and grading cotton.

Cotton problems that the cotton farmer has not been able to solve satisfactorily are (1) growing a product of uniform quality and length of staple; (2) selling this product to the best advantage.

Some of the things that he can do to help solve these problems are to (1) grow a variety that has a staple of at least one inch in length; (2) take only dry cotton to the gin; (3) insist that the ginner regulate the speed of the saws so that they will not damage the staple; (4) store the bales where they will not be damaged while he is waiting to sell; (5) learn enough about classing and stapling cotton to be able to estimate fairly accurately what his product is worth at the current price; (6) pool his cotton with that of his neighbors when he is ready to sell.

Since the first three of these practices have been discussed in previous jobs, they need not be further developed here.

Methods of Storing.—(Fig. 34.) Beginning in November, 1918, the U. S. Department of Agriculture conducted six tests of about seven months each, to determine the amount of weather damage to cotton handled in various ways. These tests were made at different points in Arkansas, Texas, North Carolina, and Georgia. Seven bales were used in each test. Bale No. 1, for example, was handled the same way at all tests, and similarly for each of the remaining bales.

Effect of Weather on Cotton

Bale No.	Storage	Method of Handling	Av. Loss in Pounds for Six Tests
1	Warehouse	Left alone	4
2	On edge on poles	Turned after each rain or once each week	19.5
3	On poles covered with tarpaulin	Left alone	10
4	Placed flat on side on ground	Left alone	273.5
5	Placed on end on ground	Left alone	117
6	Placed on edge on ground	Left alone	109
7	Placed on edge on ground	Turned after each rain or once each week	64

How is the cotton stored at your farm and in your community?

Stages of Weather Damage.—There are two stages of weather damage to cotton. The cotton becomes mildewed, which does not greatly weaken the fiber. The damage lies in the fact that the grade is lowered because of stains or discoloration. The second stage is one of decayed fiber due to fungi which, according to cotton experts, do the most serious damage in warm weather.

Classing and Stapling.—It is true that the farmer who handles comparatively few bales of cotton each year cannot become expert at classing and stapling cotton, but he can learn enough to be able to judge fairly accurately what his cotton is worth at the market price. (Figs. 35 and 36.) In many communities of the South, teachers of vocational agriculture have organized groups of farmers in classing and grading cotton. Frequently, local cotton buyers have gladly assisted in conducting such work. The teachers have been able to secure from agricultural colleges or from the U. S. Department of Agriculture samples that illustrate the government standards shown below.

"The purpose of classing is to take the cotton as it comes from the farm and put the bales of like grade, staple, color and character into separate lots so that the farmer can sell his cotton on its merits and the

FIG. 35.—Vocational agriculture boys classing cotton, Texas.

FIG. 36.—Vocational agriculture boys classing cotton, Texas.

spinner can find what he requires with the least amount of effort and expense." (U. S. Farmers' Bulletin 1445.)

Nine standard grades of American cotton are universally recognized. Middling is the grade upon which price quotations are based. Grades

above middling usually bring higher prices, and grades below middling lower prices than those quoted for middling.

Universal Standards for American Cotton

No. 1 or Middling Fair.
No. 2 or Strict Good Middling.
No. 3 or Good Middling.
No. 4 or Strict Middling.
No. 5 or Middling.
No. 6 or Strict Low Middling.
No. 7 or Low Middling.
No. 8 or Strict Good Ordinary.
No. 9 or Good Ordinary.

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No. 3 Tinged, or Good Middling Yellow Tinged.
No. 4 Tinged, or Strict Middling Yellow Tinged.
No. 5 Tinged, or Middling Yellow Tinged.
No. 6 Tinged, or Strict Low Middling Yellow Tinged.
No. 7 Tinged, or Low Middling Yellow Tinged.

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No. 3 Stained, or Good Middling Yellow Stained.
No. 4 Stained, or Strict Middling Yellow Stained.
No. 5 Stained, or Middling Yellow Stained.

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No. 3 Blue Stained, or Good Middling Blue Stained.
No. 4 Blue Stained, or Strict Middling Blue Stained.
No. 5 Blue Stained, or Middling Blue Stained.

Methods of Marketing Cotton.—The southern farmer is always assured of a market for his cotton. The price may be unsatisfactory to him, but nevertheless he knows that there is always a buyer who is ready to pay cash for one bale or a thousand any day in the year. There are two reasons why this is true: (1) Cotton is not a perishable product. (2) The market channels are always open for southern cotton. These market channels are always open because there is a buyer ready to buy, a banker ready to furnish the money, a railroad ready to haul the cotton, a warehouse open to receive it, and a ship ready to carry it to the spinner. The farmer may ask himself if he can get what his cotton is worth, but he never has to ask if he can sell it.

Marketing Services.—These agencies stand ready to perform this service because they find it financially profitable to do so. Whether or not they receive too much for these services is a debatable question. When considering the cost of getting the cotton from the field to the mill, it is well to keep in mind the fact that some of these charges cannot be lowered very much: cost of ginning, the banker's rate of interest on the money required to handle the cotton, the compress fee, railroad rates, warehouse fee, ocean rates, insurance charges, and the brokerage fee. All of these costs of marketing are paid out of the difference between what the farmer gets and what the spinner pays.

Coöperative Services.—The grower can sell his cotton to the local buyer, or he can sell through a coöperative marketing association.

The services that a farmer's organization renders its members are set forth by the Texas Cotton Coöperative Marketing Association: (1) classing by disinterested experts; (2) warehousing, storing cotton at a cost of one cent a day, with the first 30 days storage free; (3) selling the "city crop." In five years the association, through this service alone, returned to the members approximately $200,000; (4) preventing dumping; (5) selling direct to consumer in various markets of the world; (6) preventing country damage; (7) providing cheap insurance. In 1926 the rate paid by the association per $100 valuation amounted to 13½ cents; (8) securing cheap money to handle the crop. The Association in 1926 secured 4¾% interest rate; (9) furnishing certified seed at wholesale prices; (10) lending money for producing the crop.

Marketing Problems.—There are several things about marketing which the farmer must keep in mind:

1. He cannot individually perform the service necessary to get his cotton to the spinner. Either cotton merchants or coöperative marketing associations have to do this for him.

2. This service costs money. The reasonableness of this charge depends upon the efficiency and the honesty with which the service is performed.

3. The success of coöperative farm marketing organizations depends upon the efficiency of the management, and the degree of intelligent coöperation given by the members.

Things to Make at Home.—Make beds for hauling seed cotton; install steelyards or other scales for weighing; build storage shed.

References to State Bulletins and Circulars.—Ky. Circ. 161; N. M. 141; Ark. 195, 197, Circ. 162, 231; Okla. 157, Circ. 32; S. C. 209, 219, 225, 227; Tex. 339, 346, 360, Circ. 31; Ala. 219, Circ. 67, 92; N. C. 124, 195, 227, 250, Circ. 137; Fla. 15, 165; La. Circ. 73.

CORN ENTERPRISE

By Dudley M. Clements, B.S.A., M.A.

Tennessee State Supervisor Vocational Agriculture

Analysis into Jobs.—The following jobs include the main managerial and operative units in the corn enterprise. References are made to U. S. Farmers' Bulletins. See also *The Corn Crops* by Montgomery and *Corn* by Bowman and Crossley.

1. Determining possibilities with corn. 414.
2. Deciding on acreage, soils and fields. 537, 1149.
3. Growing cover crops and supplying organic matter. 579, 894, 1142.
4. Choosing type and variety.
5. Obtaining good seed; selecting from the field; improving corn. 1175.
6. Caring for and storing the seed. 537.
7. Culling ears and selecting for exhibit purposes.
8. Testing ears for germination. 428, 948.
9. Keeping records. 511, 572, 782, 1182.
10. Buying and mixing corn fertilizers.
11. Preparing the soil for planting corn; spring fallowing.
12. Planting and fertilizing corn.
13. Cross-harrowing and cultivating corn. 773.
14. Controlling enemies of corn. 875, 891, 915, 950, 1025, 1029, 1124, 1176, 1498.
15. Making corn silage.
16. Making fodder and harvesting ears.
17. Harvesting with livestock.
18. Storing and marketing the crop. 915, 1029.

Job 1. Determining Possibilities with Corn

Conditions Usually Found.—(1) Farmers know that corn is essential to their business. (2) Some farmers realize that production costs can be decreased. (3) A few farmers produce enough corn to feed livestock, and some have a surplus to sell.

Aims.—Growers and students should know the value, uses and importance of the corn crop; and the soil and climatic conditions required for success with corn.

Problems for Study and Discussion.—(1) Compare acreage and production in your state with those that border you.

2. Study the origin of corn and give reasons why the southern states should increase corn production.
3. Ascertain the markets and uses of corn and its products and determine whether there is danger of overproduction.
4. Find out whether your community mostly buys or sells corn. Is the same true of your state?
5. Ask the farmers of your community what type of soil is most suitable for corn production.
6. Talk with farmers who make high yields and low yields and determine the causes of the differences. (Fig. 37.)

7. Determine uses made of corn in your community.
8. Calculate the labor involved in producing corn compared with other crops of your community.
9. What enemies would limit the production of corn in your community?
10. What are other limiting factors?

Activity.—Make a wall chart showing the yields and acreages of corn in your state, adjoining states, your county and adjoining counties.

FIG. 37.—Father and son's corn showing that good methods pay. Son's corn on right, father's on left. (Glenwood, Ark., Agricultural Department.)

The Scope of the Corn Crop and Its Possibilities.—The power of the corn grain to multiply itself from the standpoint of weight exceeds that of any other single grain grown for domestic purposes. One grain planted in the spring will produce within a few months from five hundred to a thousand grains of corn. The acreage planted to corn in the United States exceeds ninety-five million acres for all purposes. Only a few more than twenty-nine million acres are located in the thirteen southern states. Recent reports give the yield for the United States as 2,190,012,000 bushels, of which only 655,099,000 bushels, or 25 per cent, were produced in the thirteen southern states. The average yield per acre ranges as low as fourteen bushels for some of the states, and in no state does the average exceed thirty-three bushels. This low average includes corn grown on poor soil, with ignorant labor and unimproved methods. However, in all of the corn states individual records of more than one hundred bushels per acre have been made many times. In corn contests the boys of the southern states have carried off the honors almost every

FIG. 38.—The corn project of Chester Hicks, Tyner, Tenn. Yielded 110 bushels per acre because improved methods were used.

time. Rans Beerden of Tennessee made an official record of 112.7 bushels of corn per acre on four acres. Vocational agriculture boys make yields that usually double the state averages (Figs. 37 and 38).

Corn Uses.—Corn is the basis of livestock feeding, and corn and its products are used for human food. Corn grain is fed to hogs, cattle and work stock. Cracked corn is fed to poultry and sheep. Corn silage is fed to dairy cattle, beef cattle and sheep. Corn for human food is used for roasting (Fig. 70), canning, meal, grits, hominy and flakes. Corn starch is a manufactured product of corn. Corn oil, corn sugar and corn syrup are products that are growing in importance.

FIG. 39

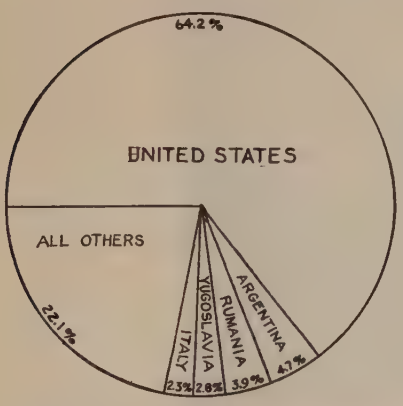

FIG. 40

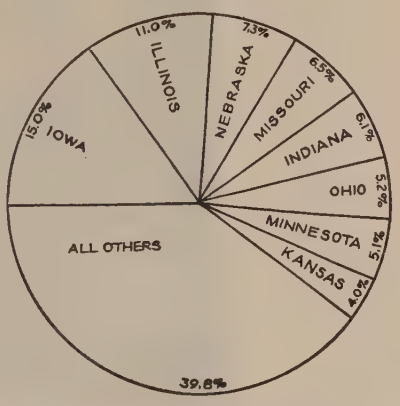

FIG. 39.—World's production of corn. Percentages by countries. 1922–1926 inclusive.
FIG. 40.—Production of corn in United States. Percentages by states. 1922–1926 inclusive. (Chamberlain's Geography.)

The southern states as a group are buying corn rather than selling it. Not all farmers in the southern states produce enough corn to feed the livestock on their farms. The farmers of the southern states do not produce nearly as much livestock as is possible. If more corn were grown more livestock would be raised. There is abundant room for the extension of corn growing in the southern states.

Climate and Soil for Corn.—In 1492, Columbus landed in the region of the southern states and found corn thriving as a native plant. Corn is a lover of fertile soil, abundant rainfall, warm temperature, and bright sunshine. (Figs. 39 and 40.) There abounds in the southern states much land that is unfit for corn growing, but there is also ample land in creek bottoms, river bottoms and other fertile places that will grow all the corn needed. Suitable soil can be found in any state on almost all the farms.

Reduction in Labor Costs.—Factors that enter into the reduction of labor costs are (1) choice of good soil; (2) rotation of crops; (3) improvement of varieties; (4) careful selection of seed; (5) applying the best methods of cultivation; and (6) judicious use of fertilizers (Fig. 42). By increasing the yield per acre the cost of production per bushel can be decreased. These may be demonstrated in boys' projects (Fig. 41).

FIG. 41.—A clear sign should be erected by each student, designating his project and what trials if any are involved. (Clarksville, Tenn., High School.)

Job 2. Deciding on Acreage, Soils, and Fields

Conditions Usually Found.—(1) Some farmers do not plan on the acreage needed. (2) Too often farmers do not realize the importance of carefully choosing soils for corn. (3) Too few farmers plan their rotations in advance.

Aims.—(1) Students should learn to know good soil for corn. (2) They should learn how to improve soils when needed. (3) They should learn to plan rotations in advance.

Problems for Study and Discussion.—(1) Under what conditions may corn be grown successfully year after year on the same soil?

2. Why do not all types of soil suit every variety of corn?
3. What influence has previous cropping on the success of a corn crop grown on the same field?
4. Find out how many farmers in your community plan ahead for corn. What do they do?
5. Tell about rotations practised by farmers of your community.
6. Why do not the farmers of your community usually grow approximately the same number of acres of corn each year?

7. Find what acreages are grown to fill silos in your community. Average these.
8. Find what acreages are grown for herds of hogs or cattle in your community.
9. Compare sizes of fields with numbers and kinds of animals.

Activities.—Draw plans of good farms. In each field write the rotations. A wall chart should be made of one of the best.

Kinds of Soil.—New soil is used extensively for corn growing. This is land that has just been cleared and on which no tillable crop has been grown. The power of corn to make use of plant food in its crudest form is the reason this practice is carried on by farmers. New soil is very limited, as most of the timber has been cleared away. Corn was born in

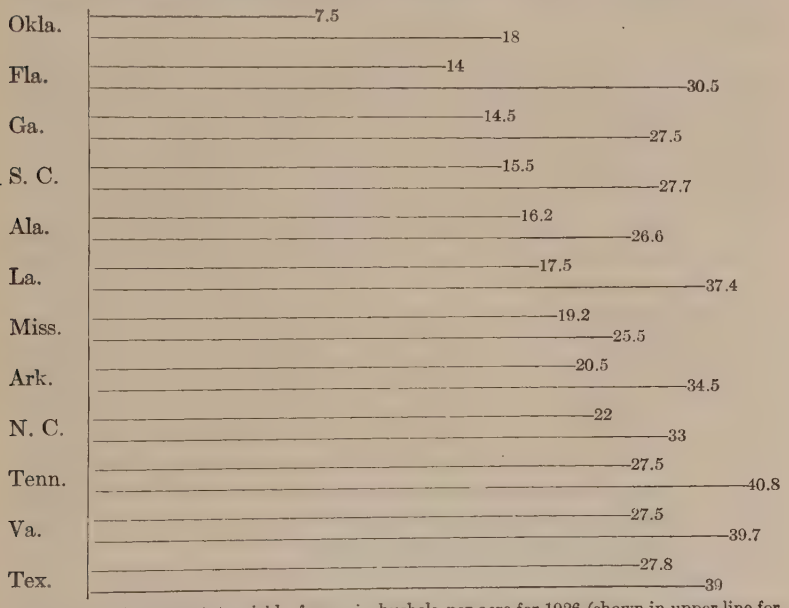

Fig. 42.—Average state yield of corn in bushels per acre for 1926 (shown in upper line for each state) as compared to average yields from vocational agricultural students in the same year (lower line for each state). 20.1 bu. paid for cost of production as shown by vocational records in Tennessee in 1926.

a new soil. Any open or cleared spot that the Indians could find they used for planting corn. Corn is a lover of much soil moisture, organic matter, and nitrogen. The more organic matter a soil contains the greater its water-holding capacity and nitrogen content. New soil has had an accumulation of organic matter over a period of years and is very suitable.

The best corn soils are found in bottom lands where rivers or creeks overflow each year and make a new deposit of silt and organic matter. The clay loams found in bottoms are good for growing corn if they are well drained. The clay and the organic matter give the soil good water-holding

capacity. This prevents the crop from suffering during a drouth. Soils that have grown crops of clover, alfalfa or grass will grow good corn if these crops are turned under to furnish organic matter and nitrogen.

Poor Corn Soils.—Soil on the uplands, that has been depleted in organic matter and is eroded, is not good for corn. Low land that has water standing on it much of the time is not good for corn. Sandy soils, being incapable of holding moisture and usually lacking organic matter, do not produce good crops of corn.

Determining the Acreage.—Many factors enter into this problem: (1) The fertility of the soil. (2) The purpose of the crop. (3) The yield expected. (4) The place in the rotation.

The fertility of the soil plays a large part in the acreage needed. Any good farmer is usually a good manager. He plans ahead and knows several years in advance what field of his farm will be planted to corn. If his fields are not all of the same size or of uniform fertility he adjusts his operations to his corn crop. He knows he must produce enough for his work stock; and he may provide more hogs or other livestock to use his corn crop or he may sell it as grain. If his acreage is small he may curtail his livestock operations. Farmers have good ideas of the yields of corn to expect on their farms.

Clover Rotation.—Corn or grain sorghum should have a definite place in the crop rotation on every farm. To continue to plant corn on the same field year after year depletes the fertility of the soil and reduces the yield of the crop. Because corn is a lover of moisture, organic matter and nitrogen, it should follow red clover, alfalfa, crimson clover or other clover. The general practice in localities where clovers and small grains are grown is to plant wheat or oats in the fall, sow clover in the spring, use the clover for grazing the first fall, cut it for hay the second year, turn under and plant to corn the third year.

In cotton sections, rye and vetch or crimson clover can be sown in the cotton rows; this winter cover crop can be turned under in the spring, followed by cowpeas or soybeans to be turned under in the fall, and a winter cover crop of rye and vetch to be turned under in the spring; and then the field may be planted to corn. This will give three crops of green manure in the soil between the cotton and the corn. Most of the southern soils should have cover crops on them in the fall to prevent the leaching of the nitrates.

Job 3. Growing Cover Crops, and Supplying Organic Matter

Conditions Usually Found.—(1) Relatively few farmers sow cover crops to plow under for corn, and many do not realize the value of green manure. (2) Some farmers fail to care properly for the barnyard manure and apply it at proper times. (3) The value of humus in growing corn is not always realized.

Aims.—(1) Young farmers should learn to know the value of cover crops. (2) They should know how to grow them and use them as green manures. (3) They should know how to get the most value out of barnyard manure.

Problems for Study and Discussion.—(1) Describe cases of bad erosion and wind blowing.

2. Work out a rotation that would keep the fields of your farm in winter cover crops.
3. Ask farmers who plant cover crops to tell the ways in which they use them and discuss these.
4. Tell what crops are grown as winter covers in your region.
5. Find usual dates of planting winter cover crops and compare them.
6. Find what rates of seeding are used.
7. In what ways is the soil prepared for cover crops?
8. Take two cases and compare cost of providing a winter cover through (a) a good rotation, (b) growing special cover crops.
9. What is green manure?
10. Find from farmers whether or not they use green manures for corn.
11. What crops are used as green manures in your community? Which are best?
12. Get farmers to estimate value of a crop of each in tons of manure.
13. Calculate the number of pounds of nitrogen put into twenty acres of land by turning under a ton crop (dry weight) of crimson clover.
14. How much nitrate of soda (15 per cent) would the farmer have to buy to supply this much nitrogen?
15. What would it cost him?
16. What would it cost a farmer to put in and turn under this crimson clover?
17. What credits other than for the nitrogen could be given the crimson clover crop?
18. Why is crimson clover better than rye to turn under for corn?
19. Calculate the number of tons of manure produced on an average farm in your community.
20. Calculate the amount of manure that is saved and applied on the average farm.
21. Estimate the amount that is wasted.
22. Calculate the pounds of nitrogen, phosphoric acid, and potash the total amount would make.
23. At market prices what would be the cash value of the three plant foods produced?
24. How much money does the farmer lose because he does not save it all?
25. Ask farmers what methods they use in saving barnyard manure.
26. Calculate the pounds and the value lost through poor storage facilities.

Activities.—(1) Locate cases of erosion on two farms of your community and plan methods and assist in preventing further erosion. (2) Visit a field where a green crop is to be turned under. Assist in completely turning under the crop.

Values of Cover Crops.—A crop that will stay green during the winter and protect the soil is a winter cover crop. Cover crops are valuable to the soil in that they (1) prevent erosion, (2) prevent leaching, and (3) provide green manure to turn under.

Erosion.—Soils may be eroded by water and by wind. Soils are eroded by wind when they are dry or when freezing causes heaving and the top crust is blown away. Heavy rains cause soil on sloping lands to wash away. Unnecessary washing is sometimes caused by poor judgment in plowing—plowing a hillside in straight rows rather than with the curve of the hill. Erosion is prevented by terracing and by sowing cover crops. On sloping fields a combination of both may be better than either alone.

Green Manure.—All cover crops that are turned under will add organic matter in the form of green manure to the soil. The more organic matter a soil contains the more micro-organisms it will have. The work of these bacteria helps make the plant food available.

Preventing Leaching.—A great many of the soils in the South are sandy. Sandy soils are very susceptible to leaching. The summers in the South are very hot and the nitrogenous plant food is converted into soluble nitrates. By fall the soil is rich in these. If no winter cover crop is present on any field the nitrates are leached out and washed away and succeeding crops are not able to use them. If a winter cover crop is grown the nitrates and other soluble plant foods will be taken up, and when this

FIG. 43.—Corn and velvet beans were grown together in this project by Eugene Campbell at Albertville, Ala.

crop is turned under the following spring the succeeding corn crop will get the full benefit of all the plant food.

Value of Legumes.—Some cover crops, such as red clover, vetch, crimson clover, and other legumes, have the power of taking nitrogen out of the soil air and putting it into their tissues and later into the soil in addition to adding organic matter. Rye, wheat, oats, and barley are not able to add nitrogen to the soil.

Some Cover Crops and Their Uses.—The most widely used cover crops are the clovers and the small grains or a combination of both. Red clover is usually sown in wheat or oats and helps this small grain serve as a cover crop the first winter, serves as a cover crop and a pasture crop in the summer and winter, provides hay and grazing the

second summer, serves as a cover crop that furnishes grazing, prevents leaching, gathers nitrogen and provides an abundance of organic matter for the corn crop that succeeds it.

Crimson clover performs all the functions of red clover but is usually sown in the late summer or very early fall and is pastured all the first winter. In the spring it is turned under, and the field is planted to corn or other crop. Crimson clover requires less lime in the soil than does red clover. In the Gulf States burr clover is often preferred.

Hairy vetch can be sown with winter grain and crimson clover. If it is not plowed under until the seed pods have matured, the crop will reseed itself from year to year.

Grazing.—Cover crops not only furnish fertility to the soil and prevent leaching but they furnish excellent grazing for livestock, especially sheep and hogs. Farmers should plan a livestock grazing program along with their cover crop and companion crop program. Manure is thus added to the soil. (Fig. 43.)

Barnyard manures vary in amounts and value. The value is affected by the character of feed given the animals and the bedding used. Manure is a complete fertilizer, because it contains all the plant-food

Average Composition of Barnyard Manure

Fresh Animal Manures	Nitrogen		Phosphoric Acid		Potash		Value 1000 lbs. live wt.	
	In Ton	Year	In Ton	Year	In Ton	Year	Value Ton	Year
	lbs.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*		
Horse	12	125	6	48	11	43	$6	84
Cow	7	171	3	26	8	108	4	78
Sheep	16	8	5	6	13	14	8	92
Swine	9	12	4	11	12	12	5	160

BARNYARD MANURE

Adds organic matter
Improves soil structure
Furnishes plant food
Unlocks plant food
Warms by aëration
Adds and feeds bacteria
Increases water absorption
Retards leaching
Reduces evaporation

elements used by the corn crop. It contains in addition organic matter and bacteria.

To be able to get the most out of manure it should be applied to the field as it accumulates. If a field of crimson clover is to be planted to corn, manure applied to the clover will help the corn directly and also indirectly through the clover.

Job 4. Choosing Type and Variety

Conditions Usually Found.—(1) Some farmers do not attach much importance to selecting varieties. (2) Some farmers know the special characteristics of certain varieties.

Aims.—(1) Farmers and students should know the classes of corn and their uses. (2) They should know the characteristics of different varieties. (3) They should be able to choose best varieties for special soils and special purposes.

FIG. 44.—Seventy-two bushels of certified seed corn on one acre produced by a vocational agriculture boy in his project at Blacksburg, Va.

Problems for Study and Discussion.—(1) Make a list of all varieties grown in your community.

2. Ask farmers which are best for market grain; which for fodder.
3. If any varieties have local variety names find the full history of each.
4. What varieties are considered "prolific"? Why?
5. Be able to tell the special characteristics of each variety in the region.
6. Study samples of varieties standard to your state.
7. Be able to recognize and describe each variety.
8. What classes besides dent corn are grown locally?
9. How is each used?

Activities.—(1) Bring in samples of all varieties grown in your community. (2) Mix single ears of several varieties and have a contest in identifying each. (3) Make a chart or blackboard table classifying varieties of your state as to uses—fodder or silage, grain, upland, bottom land. (4) Outline plans and pursue a project to produce certified seed corn (Fig. 44).

Classes of Corn.—Corns may be grouped into the following six classes:

1. **Pod corn** has no economic value but it is interesting because each grain is covered with a husk like the grain of wheat. It shows the relationship of corn to other grains like wheat, oats, barley, rye, and the wild form from which corn has been bred.

2. **Pop-corn** is a very small-eared corn with exceedingly hard and flinty grains. The types are pearl and rice. The colors are yellow, white, red, blue, and mixed. The explosion of volatile oils within the grain causes it to burst open when heated. This process gives a fluffy white product which has quite a sale value as buttered pop-corn. It is also used in making confections.

3. **Soft corn** or flour corn, like pod corn, has no economic importance in this country. Sometimes it is used for flour in mixing with wheat flour.

4. **Sweet corn** is grown primarily for table use, roasting ears, and canning. The grains are full and soft until dry, then they become shriveled or wrinkled. Sweet corn contains sugar as well as starch. Yellow varieties are growing in popularity because of their content of vitamins. Golden Bantam is one of these.

5. **Flint corn** is a hard flinty corn when mature. The grain is smooth, rounded, glazed and very hard. It is grown primarily in Canada, New England states and some of the northern states of this country. It will mature very early and is therefore adapted to regions with short growing seasons. There are many prolific varieties in this class, but they are seldom grown in the South.

6. **Dent corn** is the most universally grown of the six classes. The grain of this corn is indented at the top at maturity. The endosperm is not so compact as in the flint corn and the outer layer is not nearly so hard. Some of the varieties have been developed to mature in the upper northern tier of states.

Varieties of Dent Corn.—There are now several hundred varieties of dent corn grown. The name of a variety is of little importance as compared to vigor, adaptability, uniformity, productiveness, and purity and vigor of seed.

Station experiments show a large variation in vigor, productiveness, and adaptability. The Tennessee Station found that in average annual yields there was a variation of 25 per cent between the superior and inferior varieties.

Some varieties are well adapted to rich bottom land while others are more suited to upland soils. Some varieties have the power of producing two or more ears to the stalk while others produce only one. Some varieties yield more grain while others produce a large amount of fodder or silage. Farmers should take the recommendations from their own state stations given to county agents and to teachers of vocational agriculture as to varieties best suited to their soils and conditions and for

different purposes. There is a tendency on the part of farmers to order corn from a great distance, but corn grown a great distance away will come in contact with different climate, soil, and other conditions. Farmers should plant good varieties grown near them and keep these varieties pure. One variety may be good for a certain community or county, but not for the whole state. Variety descriptions are adapted from a Tennessee Station bulletin.

Albemarle.—This variety is credited by the Tennessee Station to Albemarle county, Virginia. It is a typical white-grain and white-cob prolific; grown extensively on the better classes of soil in Virginia and to some extent throughout the South. Although a high grain producer on fertile soil, it is considered to be especially valuable for silage purposes. It requires a medium season. The stalk is rather tall and the ears are set rather high on the stalk. The ears are extra sound, of fair length, but slender. The grain is shallow and inclined to be flinty.

Objections to this variety by farmers are (1) Ears of small size and set too high on the stalk. (2) Grain too hard. (3) Adapted only to fertile land.

Favorable qualities are (1) Soundness. (2) High yielding capacity of both grain and stover on fertile land.

Standards suggested for show purposes are (1) Length, 9½ inches. (2) Circumference, 5½ inches. (3) Number of rows 10 or 12. (4) Percentage of grain 85.

Biggs Seven Ear.—About the year 1893, Noah Biggs secured a few ears of corn from an attractive field which he saw growing in Halifax county, North Carolina. He afterward gave attention to the improvement of the variety, and it became widely known as Biggs Seven Ear. It is highly thought of in North Carolina, and is grown to some extent in various parts of the South. This variety produces small-sized ears with white cobs and grain. It is a true prolific, having a strong tendency to produce several ears to a stalk, and appears to be well suited to all kinds of soil.

Hickory King.—This is a well-known variety, developed since 1880 by A. O. Lee, of Hickory, Virginia. The ears are slender but the cob extra small, so that the percentage of grain is high. The grain is white, rather hard, large, disc-shaped, and moderately dented. The number of rows is usually 8 but sometimes 10 or 12. It develops in seasons of medium length for the South. The vigor and height are good. Under favorable conditions one- and two-eared stalks are almost equally common. The ear is well protected by the husk, which fits rather closely.

Objections to this variety by farmers are (1) Ears small. (2) Grain hard. (3) Ears somewhat hard to husk. (4) Yield moderate.

Favorable qualities are (1) Soundness. (2) Good milling quality. (3) Fair adaptability to all kinds of soil. (4) Ease of recognition.

Standards for show purposes are (1) Length, 9½ inches. (2) Circumference, 6¼ inches. (3) Number of rows 8 or 10. (4) Percentage of grain 88.

Huffman.—This variety has been grown for many years. It was obtained by G. C. Huffman, of Normandy, Tennessee, by long-continued selection from a large-eared mixed variety, in which white grain and cobs predominated, but which carried some red cobs and blue-colored grain, both of which were finally eliminated. Huffman corn has won many a grand championship as show corn over all competitors at state fairs.

It is a late-maturing, large-stalked variety, with ears set high on the stalk. One ear to the stalk is the rule, though two ears are not uncommon. The ears are large, with deep, shallow-dented grain and small cob. The number of rows is 14 to 18. The variety is well standardized, so that it can be readily distinguished from all others.

Objections to this variety by farmers are (1) Lateness of maturity and the slow drying out, or curing, of the ears. (2) Adaptation to rich land only. (3) Extra-heavy stalk, with ears too high on the stalk.

Favorable qualities are (1) High grain yield under favorable conditions. (2) Heavy total yield for silage purposes. (3) One large ear to husk instead of two small ones as in a prolific variety. (4) Excellent for milling purposes.

Standards for show purposes are (1) Length, 10½ inches. (2) Circumference, 7½ inches. (3) Number of rows 14 to 18. (4) Percentage of grain 88.

Jarvis Golden Prolific.—This variety was developed by J. M. Jarvis, Winston-Salem, North Carolina, who followed field selection from stalks which produced two good ears. Probably other points were kept in mind, but the chief consideration was yield. This variety proved of merit in station trials in North Carolina and Tennessee. It is of high merit, particularly as it appears to be one of the best-yielding yellow corns for all kinds of soil. The stalk is medium in height, appreciably shorter than that of Albemarle prolific, and the ears are set rather low on the stalk. The ears are rather small, the grain is of moderate depth, only slightly dented, rather hard, and extra sound. The cob is white, an unusual color for a yellow dent corn, but of decided advantage in distinguishing this variety from others.

Objections to this variety by farmers are (1) Tendency to lodge more than some varieties. (2) Ears rather small. (3) Grain rather hard.

Favorable qualities are (1) High yield of grain on all soils. (2) Soundness. (3) Easily distinguished grain.

Standards suggested for show purposes are (1) Length, 9 inches. (2) Circumference, 6¼ to 6¾ inches. (3) Number of rows 12 or 14. (4) Percentage of grain 87.

Neal's Paymaster.—This is a red-cob white corn developed by W. H. Neal of Lebanon, Tennessee, who persistently selected seed corn in the field, using only those plants that produced two good-sized ears to the stalk. Growers like it because it yields well. It is a medium-season variety, with good, but not over-sized, stalk, and ears set at medium height on stalk. With a favorable soil and season, two ears to the stalk are the rule, provided the planting is not too thick. The ears are medium to small in size. The grain is a rather dull-colored white, of good depth, medium dent, and fair soundness.

Objections to this variety by farmers are (1) Grain not as sound as desired. (2) Somewhat more damaged by stalks being blown down or broken off than some other varieties. (3) Lack of grain or ear characters which would enable it to be readily distinguished from a number of other varieties.

Favorable qualities are (1) Yield of grain high on all soils. (2) Ears easily husked. (3) Grain not too hard. (4) Stands considerable variation in rate of planting without change in yield.

Standards suggested for show purposes are (1) Length, 9 inches. (2) Circumference, 7¼ to 7¾ inches. (3) Number of rows 14 or 16. (4) Percentage of grain 87.

Piedmont White Dent.—This was obtained from crosses between Hickory King and Boone County White near Washington, D. C., and is grown to a limited extent in parts of Maryland, Virginia, North Carolina, and Tennessee. This is a white-cob and white-grain variety, maturing in about 120 days when planted in late April. The stalk is short, the ear is slightly tapering, of good size, but only moderately well covered with husk. The grain is of medium depth and dent. The number of rows varies from 14 to 20. One ear to the stalk is the rule. Both the high yielding capacity of this variety and its short season make it especially suited to the higher altitudes of the South. It is also believed to be well suited to average soil.

Objections to this variety by farmers are (1) Only moderate soundness. (2) Ears not well covered with husk.

Favorable qualities are (1) High yield on land medium to low in productiveness. (2) Short season sufficient. (3) Ease of gathering and husking.

Standards suggested for show purposes are (1) Length, 9 inches. (2) Circumference, 7¼ to 7¾ inches. (3) Number of rows 14 or 16. (4) Percentage of grain 85.

Webb Improved Watson.—In 1890 M. C. Webb, Bedford County, Tennessee, began to plant Watson corn, a well-known variety in his section. By continued crib selection he developed a definite strain known by his name. It is a white-cob, white-grain variety of good appearance

with a medium length of season. The stalk is of medium size. The ears are sound, of medium to short length.

The chief objection to this variety is that it is adapted to rich soil only. On poor or medium soil the yields are low.

A favorable quality is its soundness, and in this respect it is almost unsurpassed.

Standards for show purposes are (1) Length, 9 to 9½ inches. (2) Circumference, 7½ to 7¾ inches. (3) Number of rows 18 to 24. (4) Percentage of grain 86.

Job 5. Obtaining Good Seed; Selecting from Field; Improving Corn

Conditions Usually Found.—(1) Many farmers practise some kind of selection of seed. (2) Too few use the best methods of selecting corn. (3) Very few make any effort to improve their corn.

Aims.—Beginners should learn the value and methods of selecting seed in the best way to improve corn.

Problems for Study and Discussion.—(1) Visit corn fields and make notes of characteristics of good stalks.

2. Why should stalks as well as ears be considered in selecting seed corn?
3. Report methods of selecting corn on your own farm and on farms of your neighbors.
4. How is corn pollinated?
5. Why does corn not always come true to type selected?
6. To what extent may you depend on the rule "like produces like" when selecting seed corn?
7. Debate field selection vs. crib selection.
8. At what time should field selecting be done?
9. Describe the work.
10. Calculate how many ears of corn will be required to plant a thirty-acre field. Allow 50 per cent for culling by selection and testing.

Activities.—Select ten ears, or enough for planting a field, from a corn field according to best methods used in mass selection.

Crib Selection.—Some farmers keep a box in the corn crib and at the time corn is being fed to livestock the best looking ears are thrown into the box for seed. This is a poor method because the farmer has nothing to back his selection except the looks of the corn. He does not know whether this corn came from diseased stalks or from stalks with only one ear. In this method very little attention is paid to type. The germination power of crib corn is reduced by uneven moisture and temperature.

Some farmers do not even give their seed selection this much consideration. At planting time they usually go to the crib and get some corn and plant it. The corn is selected after the best corn is fed from the crib.

Field Selection of Corn.—Many good farmers put a box on the wagon at the time corn is being gathered in the field, and as a good ear is found it is placed in the box. This is possible where corn is snapped from

the standing crop. There is little opportunity to observe the characteristics of the stalks.

The best method of selecting corn is for the farmer to go into the field before gathering time for the sole purpose of getting seed corn to plant the next season. This should be done after the corn is mature but before the stalk is dead. The husks on the ears should be dead but the stalks should be alive. This gives an opportunity to select corn from disease-free stalks.

FIG. 45.—A teacher of Vocational Agriculture of the Blacksburg, Va., High School showing a student how to select seed corn from his project.

No ear should be chosen from any stalk that is close to barren stalks. A barren stalk is a corn stalk that has produced a tassel but no ear. If an ear of corn is pulled from a stalk that is near a barren stalk, in all probability the barren stalk is one of the parents of some of the grain, and when the seed from this ear is planted the next year, barren stalks may be produced.

Ears should be selected from the best-bearing stalks that have two good ears or a number to suit the variety. The ears should be of medium height on the stalk. The ears should be borne on shanks that are sound,

not too long, and not so strong as to make the ears stand upright. (Fig. 45.) Before the ears are pulled the husk should be stripped back a little way at least in order to be sure that the tips are well filled. The husk should fully cover the tip. When the ears are pulled the shank should be examined to see that there is no evidence of disease. Ears should not be borne too high or too low on the stalks.

The stalks should be sound, should have good brace roots and be strong enough to hold upright its load of grain.

Select enough corn to allow for further culling and for testing out ears of low germination. (Fig. 46.)

FIG. 46.—Vocational agriculture class, Ashland, Miss., selecting seed corn in the field under supervision.

Improving Corn.—For farmers, mass selection is probably the best way of improving corn. By mass selection is meant the using of the best method of field selection and continuing this from year to year. First of all a variety that is true to type, suited to climate, adapted to the soil, vigorous, and productive should be chosen. When field selection begins the farmer should determine in his own mind the type of ear with reference to size and grain he desires and hew to this line as closely as possible in choosing his seed corn. If he cares to make a first and second choice within the special type he has selected he can plant his first choice in a separate plot and continue his mass selection with closer discrimination. To keep the seed pure it is necessary to plant it where there is no danger of cross-pollination from other corn fields of other varieties.

Pure-line methods of breeding have been practised at the Illinois Station. Mass selection is the basis. It is known that all kernels on an ear are not pollinated from the same male parent. Some may be pollinated by neighboring plants, some by pollen from far-off fields, and some by the pollen from the stalk that bore the ear. Kernels of corn on the same ear have different hereditary characteristics and may be entirely different in many ways. The idea is to begin with several kernels and inbreed each one by self-pollination. This naturally reduces the vigor at first but out of some of them may come a few grains that are productive, vigorous, and resistant to diseases. Two self-pollinated grains that have the inherent qualities desired are crossed and these crosses of two pure line strains will produce even more vigorous plants than if inbreeding were continued. The crossing of two strains that have been inbred is called pure line breeding.

Inbreeding reveals the weaknesses of corn grains and furnishes a way of climinating them. Inbreeding shows whether the particular plant produced from a self-pollinated grain is susceptible to smut, root rot and other diseases.

In experiments conducted by Woodworth, there were indications that some of the self-pollinated plants have the power of using plant foods, such as phosphorus, in better proportions than others. Some lines are also able to resist the chinch bug; some can withstand a drouth better than others; still others show a difference in the proportion of grain and fodder. The pure-line method should not be attempted by farmers without training but can be used with profit by farmers who have had training in plant breeding and who expect to make improved seed corn a specialty. The pure-line method of breeding is considered much superior to the ear-to-row test.

Job 6. Curing and Storing Seed Corn

Conditions Usually Found.—(1) Many farmers who select seed corn in field usually store it fairly well. (2) Few others seem to know the best methods of storage.

Aims.—(1) Growers should know how to cure seed corn for storage. (2) They should learn to store seed properly and to protect it from mice and insects.

Problems for Study and Discussion.—(1) Report on the number of farmers of your community who store their seed corn, and the methods they use.

2. Make several devices for drying seed corn, and discuss the relative importance of each.
3. Why will seed corn not be good if stored before it is properly cured?
4. Explain why carbon bisulfide will kill insects at the bottom of a tight bin when it is placed in a pan on top of the corn.
5. Explain the necessity of putting a tight cover over the top of the container when carbon bisulfide is used.
6. What containers can be used for storage of seed corn after it is cured?
7. Discuss precautions to take after corn has been stored.

Activities.—Treat a bushel of corn with carbon bisulfide. Make several devices for drying seed corn and discuss their relative values.

The Condition of Seed Corn when Gathered.—As was stated in Job 4, the best time to select seed corn is while the stalk is partly green and the husk on the ear is dry This is before gathering the general crop. Corn

pulled from the stalk at this stage has a large amount of moisture in it. The cob is very pithy and usually contains much water. This may cause corn to mold or rot if not properly cured soon. Moisture held long will destroy germinating ability.

Curing.—In order to get the moisture out, the husks should be removed, the shanks detached close to the cobs, and the ears put for about a month in a place that is dry, well ventilated, and of such a temperature that it will not fall to the freezing point before drying. An attic

FIG. 47.—Stringing up seed corn. Vocational Agri. Dept. Lincoln Memorial High School. Tenn. (F. C. Grannis.)

over the kitchen makes a good place to dry seed. It can be strung on strings (Fig. 47), put in specially built racks, put on wires (Fig. 48), or stuck on seed-corn posts made by driving headless nails in any support.

Precautions Against Mice.—While corn is being dried for storage every precaution must be taken against mice. If mice are present it may be hung from joists across the room by a wire or something too small to support mice. It must be high enough from the floor and far enough away from the wall or any object to prevent mice from jumping to it.

To protect the seed corn from mice and rats after storage it is a good

plan to have a box or bin that is lined, at the bottom at least, with fine-mesh wire or "hardware cloth" so that these enemies cannot cut through to the corn. The top of the box should be fixed in a similar manner or a strip of the wire nailed over the open end of the box. The box should be tight if moths are likely to be present.

Storage.—When the corn has been drying for about a month and there is no evidence of excessive moisture in the cob, the corn can be

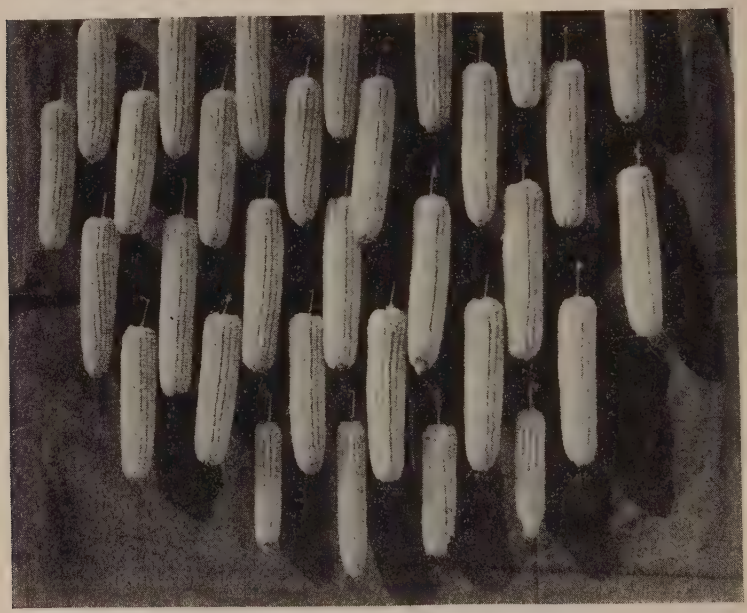

FIG. 48.—Wilson, Arkansas, Vocational Agricultural Department, improvement of corn by selection. Showing method of drying seed corn.

placed in barrels, boxes, bins, or large tin cans until ready for the germination tests, which precede planting. It should be examined to see that it is not sweating or molding. Ventilate and dry it more if needed.

Moths and Weevils.—A close watch should be kept for grain moths, and, in some of the southern states, for weevils. If these insects are discovered either before or after storage, the corn should be treated with carbon bisulfide in tight bins or boxes. To do this, place a saucer on top of the corn in the container and pour about a tablespoonful of carbon bisulfide in the saucer; or at the rate of one pint or more to 500 cubic feet. Cover the container as tightly as possible, at least with a tight sack, and leave for about a day. Lanterns, lighted pipes, and every kind of fire must be kept away while this treatment is

going on. If this must be done before the corn is dry enough to store, it must be returned to the drying racks. The same treatment should be applied as often as necessary to control the insects.

Job 7. Culling Ears and Selecting for Exhibit Purposes

Conditions Usually Found.—(1) Some farmers do not cull seed-corn ears after storage. (2) Few know the points to consider in culling ears. (3) Few exhibit corn at fairs.

Aims.—Growers and seed breeders should learn the process of culling for seed for breeding and for fairs.

Problems for Study and Discussion.—(1) Wherein does selection for seed purposes differ from selection for exhibit purposes?

2. What are the five main points to consider in culling for seed?
3. Compare kernels of varieties grown in your community and discuss strong and weak points.
4. Compare good and poor ears in maturity; in sizes and shapes of ears.
5. Compare ears true to type with those less true.
6. Select ears which show impurities by color of cobs or color of kernels.
7. Discuss what takes place where corn mixes.
8. Why should such corn not be planted?
9. With samples of corn that have been discarded, discuss reasons for rejection.
10. What extra points would you consider for show corn?

Activities.—Practise selecting ears of corn for seed and for exhibit purposes until you can do this rapidly and well.

Culling for Seed.—After corn has been cured until thoroughly dry, culling for seed purposes may begin. It is a good policy to select in the field a great many more ears than are needed in order that culling can be closely done. Begin culling with such factors as (1) Trueness to variety. (2) Trueness to type. (3) Maturity. (4) Purity. (5) Degree of indentation. (6) Germ condition. (7) Freeness from disease.

The entire lot can be quickly divided into two piles by hastily examining each ear to see that it is fully mature, true to variety, and pure. Ears that are too small, too large, off shape, not pure, and have external evidences of disease should be immediately discarded. After the entire lot has been rapidly sorted, close selection must be made. The ears must be examined to see that they represent the special type that the farmer or breeder has in mind. The ears should be examined to be sure the cob is of the color that belongs to the variety. The grains as a whole should be examined to see that no mixing of one color with another has taken place. A yellow variety that has the ends of the grains white has been mixed.

A white variety that shows tinges of yellow on the grains when held up to the light has been mixed.

If the cob shows any evidence of mold, the ear should be thrown out, because this is an indication of the presence of disease.

The ears should be twisted in the hands. If the cob is limber or the grains are loose the ear should be thrown out, for these are evidences of

immaturity. Chaffiness of shelled kernels also indicates immaturity. A few grains should be taken out of each of a number of ears and examined very carefully. When the grains are removed and the tips of the germs are exposed, perhaps showing brown color, the farmer should hesitate about keeping that ear. The germs should show a condition of vigor. If germs are dark colored or dead-looking the entire ear should be thrown out. The grains should be wide and full as well as deep.

Wide, deep grains indicate a large percentage of grain and a small cob. Some of the ears should be broken with a view to determining the size of cobs.

Selecting for Show.—A good exhibit of show corn should have all the good characteristics of seed corn, and a few additional fancy points must be present. These are (1) Uniformity. (2) Good ear length, shape, color. (3) Good kernel size, shape, depth. (4) Good tips and butts.

Uniformity goes a long way in deciding a show. If ten ears of corn are uniform there will be very little variation in the length of the ears, the circumference, the type of grain on the ears, the straightness of the rows, and the color of the grains. Grains may vary slightly in shades of color, indentation and type from one ear to another even in corn of one variety. Spaces between rows must be watched closely and should be uniform. Good show corn should have well filled tips and butts.

Some exhibitors make an effort to "doctor" exhibits, but it is difficult to fool a good judge. Grains that have been knocked out should not be glued in. Tips that are not well filled should not be trimmed. It is difficult to select corn for seed purposes but even more difficult to select corn for show. There is a possibility of securing one show ear in twenty good ears. Exhibits that are sent to a show with rough shanks on the butts and silks in between the rows will not win.

Job 8. Testing Ears for Germination

Conditions Usually Found.—(1) Very few farmers make a germination test before planting and some plant corn that should be fed. (2) Some farmers do not realize the losses due to poor stands.

Aims.—Young farmers should know how to test corn, and should know the value of testing.

Problems for Study and Discussion.—(1) Describe a plan of marking or arranging ears for the ear method of testing.

2. Describe the rag-doll method of testing. Tell how to interpret results of the test.
3. Determine the cause of weak germination in ears of corn.
4. Calculate the cost of thinning forty acres of corn.
5. Calculate the cost of replanting forty acres of corn.
6. Estimate the corn wasted on forty acres by planting a third too much.
7. Estimate the loss in labor, yield, and use of land on an average forty-acre field for your community, due to poor stands.

Activities.—Make a rag-doll test and keep a record of the labor involved. Calculate the loss on 100 acres of corn if all ears are planted. Test the corn for your projects and discuss results.

Methods of Testing.—The most popular method of testing seed corn for germination is by the simple rag-doll method. The pan and blotter, and the sand or sawdust box are sometimes used.

Testing by the Rag-Doll Method—To make a rag-doll tester, take unbleached domestic cotton or a worn out sheet (Fig. 49). Cut this into strips about sixteen inches wide and four or five feet long. Three inches from each side of the strip draw a line the full length of the strip. Inside these three-inch lines will be left a space ten inches wide and as long as the cloth. Within this ten-inch strip, beginning at a few inches from the end, rule off lines across the width about two inches apart. Number each line. Wet the cloth and put it on a flat board. Take the

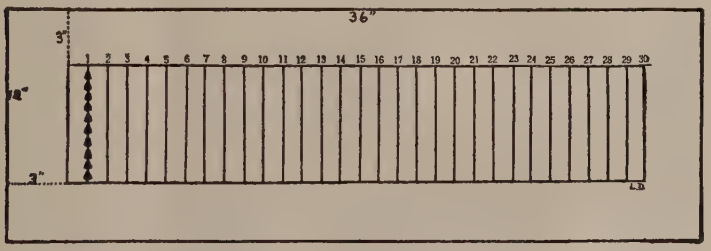

Fig. 49.—Strip of cloth or waterproof paper, marked for rag-doll tester.

ears that are to be tested and number or arrange them in a rack to correspond to the numbers on the cloth. A convenient way to number the ears is to take pieces of cardboard about one inch square, number the pieces, and with small nails fasten each to the butt of a cob. Numbered racks may suffice.

From the first ear take ten grains of corn, selecting from different rows and not from butts or tips. Place these grains from the first ear on the first cross line of the cloth. Place the grains with the germ side next to the wet cloth. When grains have been taken from all ears and placed on the proper lines on the cloth, fold over the blank ends and margins toward the center of the cloth. Now place a small smooth stick at one end and roll the entire cloth on it. When the roll is completed put on a small rubber band, or tie a string around each end of the rolled rag doll. Submerge the rag dolls in a vessel of lukewarm water for several hours. Next remove, squeeze gently, and place them in a box, like sticks of wood put side by side. Cover to hold moisture and keep out mice. Keep the rag dolls in a room of fairly even temperature, about 80 degrees F.

Keep them moist, not too wet. After about five to seven days take out the rag dolls and read the results. Ears that show weak germination should be entirely discarded. Ears that show indications of rot should not be used. All corn that fails to show perfect germination should be fed to livestock (Fig. 50).

The Purdue Station has been able to prevent the spread of mold from one space to another by using strips of glazed paper under and over the strip of cloth before rolling. Special paper for testing may be used in place of cloth. Less mold will then occur.

Fig. 50.—Vocational agriculture boys, West Lafayette, Indiana, testing seed corn. (C. W. Hemmer, teacher.)

Poor stands are more often caused by weak germination than by any other factors. Replanting vacant spaces does not pay. When a farmer plants 100 acres to corn and gets a 75 per cent stand he has lost the use of twenty-five acres of land and has lost the corn yield from that area. If the yield of the corn averages 30 bushels per acre he has lost 750 bushels of corn. At one dollar a bushel his loss has been $750, and he has been forced to cultivate 100 acres instead of 75.

Loss from Overplanting.—Most farmers plant too much corn. They have thrown away some grain that could have been profitably used in feeding livestock or in planting more land. Because the corn is too thick on the land they are forced to thin it with hoes. The heavy cost involved in thinning is a loss and the corn destroyed is lost.

Value of Testing.—Germination tests show the farmer how much corn he needs to plant if he has properly prepared the seed bed. Testing

FIG. 51.—The assistant state supervisor advising Monroe Smith, vocational agriculture student, Christiana, Tenn., about keeping records on his corn project.

FIG. 52.—Results of fertilizing corn. Rows at extreme right not fertilized. Students running trials with fertilizers should have a few rows untreated, called "check" for comparison. (F. T. Mitchell.)

takes little time and it can be done in the winter season. The time required to test seed corn repays the farmer in time saved in thinning, in

corn saved for feeding, in preventing the loss of the use of land, and in the assurance that root-rot disease will not be prevalent.

Job 9. Keeping Records

Conditions Usually Found.—(1) Very few farmers keep cost and profit records. (2) Because records are not kept, most farmers' estimates are guesses.

Aims.—(1) Farmers and students should know a simple system of records. (2) They should make and keep records. (Fig. 51.) (3) They should learn how to interpret records.

Problems for Study and Discussion.—(1) Make a list of the operations necessary in the corn enterprise.

2. Determine the expense items entering into these operations.
3. Find from farmers the usual rate for hired labor in the community.
4. What is paid locally for horse labor?
5. Find the charge made for a tractor for a day.
6. What is the actual expense involved in the operation of a tractor per day?
7. What should be allowed for the use of other corn machinery?
8. Find the cost of an 8–4–4 (P–N–K) or other fertilizer in your community.
9. Compare this with the cost of 100 pounds nitrate of soda, 200 pounds 16 per cent acid phosphate, and 50 pounds of muriate of potash, bought by the ton.
10. Ask farmers what charge should be made for land rental.
11. What should be allowed for good seed corn?
12. What is meant by total income?
13. What is net profit?
14. What is meant by total cost?

Activities.—(1) Rule off all sheets or pages suggested in this job and fill in items for a twenty-acre field of corn or for one on your farm. (2) Calculate all cost items for this field. (3) Calculate total income and net profit at market prices.

Annual Inventory.—In each farm enterprise it is important that the equipment available at the beginning of the enterprise should be recorded in a list called an inventory. At the end of the year the inventory should be gone over again in making a new list. The comparison of the two will show how much the list and its valuation have increased or decreased during the year. If valuation has increased the enterprise

INVENTORY

ITEMS	BEGINNING OF YEAR			CLOSE OF YEAR		
	Quantity	Price	Value	Quantity	Price	Value
	Total		$	Total		$
Net increase or decrease for year.....				.....		$

must be credited, if it has decreased the enterprise must be charged with the difference.

In making up each list include the kind of property, number or quantity, the price of each unit, and the value. Use actual market values at the farm as nearly as possible.

A Simple System.—In every crop enterprise there is labor expense involved in such operations as preparing soil, planting, cultivating, harvesting, and marketing.

The actual labor expense items of all farm operations of any enterprise may be kept on a single form, but the analysis of any operation is more easily made if separate expense sheets are kept of the five major operations.

LABOR RECORD

Rule the labor records to show the time and value of three types of labor.

DATE	ITEM	HIRED LABOR		SELF LABOR		HORSE LABOR	
		Hrs.	Cost	Hrs.	Cost	Hrs.	Cost
May 6th	Using two two-row planters	8	$1.60	8	$1.60	32	$4.80

The above example shows that on May 6th the grower hired a man at twenty cents per hour to operate one of his planters; that he operated the other at the same charge; and that there were four horses at work at the rate of fifteen cents per hour, each.

MISCELLANEOUS EXPENSE RECORD

There should be a page to show expenditures not included as labor, such as fertilizer, manure, seed, rent, interest, insurance, taxes, and use of implements.

DATE	ITEM, QUANTITY, PRICE	AMOUNT
Oct. 1st	Land rent for 60 acres,@ $5.00	$300.00
Jan. 1st	1 ton Nitrate of Soda	60.00

Tractor Record.—If a tractor is operated regularly on the farm, a special account may be kept of its oil, gas, grease, repairs, depreciation, interest, and taxes. Its use in each enterprise should be charged in the miscellaneous expense record or in the labor record.

RECEIPTS RECORD

There should be a page showing actual receipts and uses of the crop. Rule a page with the three columns shown. Enter in this record all sales, parts of crop fed to livestock, or used in the home.

DATE	ITEM, QUANTITY, PRICE	AMOUNT
Dec. 15th	100 bushels sold to G. E. John & Co. @ $1.00	$100.00
Feb. 1st	20 bushels seed to J. R. Wright @ $4.00	80.00

Summary Statement.—From the preceding records it is easy to make a summary at the completion of the year (or enterprise cycle) for each enterprise. For this purpose rule a page as shown.

SUMMARY STATEMENT

EXPENSES	AMT.	RECEIPTS	AMT.
Inventory, first of year		Inventory, last of year	
Miscellaneous expenses		Receipts—Cash	
Hired labor		Used for feed	
Horse labor		Used in home	
(1) Self labor			
(2) Total cost		(4) Total income	
(3) Less self labor (2) minus (1)		(5) Net income (4) minus (2)	
		(6) labor income (4) minus (3)	

Labor Income.—After calculating all expense items except the labor of the grower we may deduct this from the total receipts credited. This difference may be called the real profits or the labor income of the grower.

Job 10. Buying and Mixing Corn Fertilizers

Conditions Usually Found.—(1) Farmers usually buy fertilizers ready-mixed, by brand instead of by analysis. (2) Some farmers do not know the plant-food needs of the corn crop. (3) A few successful farmers buy separate plant foods. (4) Not many farmers home-mix their fertilizers.

Aims.—(1) Farmers should know the plant-food requirements of corn, and the commercial sources. (2) They should learn how to home-mix fertilizers.

Problems for Study and Discussion.—(1) Ask farmers what "brands" of fertilizers they buy.

2. Secure fertilizer tags of the "brands" and mixtures sold in your community.
3. Find from farmers what crops they fertilize with these "brands."
4. Determine from the analysis on each tag whether this brand meets the plant-food requirements of the crop.
5. Calculate the pounds of plant food and filler in a ton of this fertilizer.

6. What is the average cost per pound of the plant foods in this fertilizer at prices paid?
7. Calculate the cost of the same amount of plant food if 16 per cent superphosphate* 15 per cent nitrate of soda, and 50 per cent muriate of potash be used.
8. Why is it not always necessary to use a complete fertilizer on corn?
9. Compare the cost of home-mixing the plant foods in the above fertilizer with the cost of ready-mixed goods.
10. If you have 1000 pounds 16 per cent acid phosphate, 533 pounds of 15 per cent nitrate of soda, and 160 pounds of 50 per cent sulfate of potash to make up an 8–4–4 mixture, how many pounds of each ingredient must you put in a 100-pound sack to keep the same proportion?

Activities.—(1) Test growing corn crops for needs of nitrogen and of potash as described in this job. (2) Test soils for acidity.

Plant-Food Requirements of Corn.—Corn requires about one pound of nitrogen, two-thirds of a pound of phosphoric acid, and two-fifths of a pound of potash for each bushel of corn produced. A table in the Appendix shows the plant food removed by corn. To be able to maintain production the farmer should return to the soil as much plant food as is taken away. Proper conservation and application of barnyard manure and turning under leguminous crops as green manures replace some of the plant food. Nitrogen can be supplied by turning under such crops as crimson clover, vetch, cowpeas, and other legumes. The bacteria help make available some of the other plant foods, such as phosphorus and potash. Lime plays an important part in putting the soil in a physical condition, and will make available some of the plant foods. Some soils are deficient in all three. In this case phosphorus and potash must be supplied in a commercial form. (Fig. 52.) See Appendix for table showing composition of other commercial carriers of plant foods.

Commercial "Carriers" of Plant Foods, with Their Percentage Compositions

Nitrogen (N)	*Phosphoric Acid* (P_2O_5)
Nitrate of Soda, 15–16	Superphosphate, 14–20
Sulfate of Ammonia, 20	Raw Rock Phosphate, 20–36
Calcium Nitrate, 13	Tankage, 3–8
Cyanamid, 20	Cottonseed Meal, 2–3
Cottonseed Meal, 6	Bone Meal, 21–25
Leuna Saltpeter, 26	*Potash* (K_2O)
Dried Blood, 6–15	Sulfate of Potash, 50
Tankage, 6–8	Kainit, 12
	Cottonseed Meal, 2–3

Making up Mixtures.—These commercial forms are put together with possibly some filler to make a ton of mixed goods. If a farmer bought

* The old trade name "superphosphate" is being revived. It has always meant the same as acid phosphate, and is preferred by the National Fertilizer Association and the Association of Official Agricultural Chemists.

an 8–4–4 (P–N–K) fertilizer for his corn crop and it was made up of a 16 per cent acid phosphate, 15 per cent nitrate of soda, and 50 per cent sulfate of potash, he would have in this mixture of one ton, 1000 pounds of acid phosphate, 533 pounds of nitrate of soda, 160 pounds of sulfate of potash, and 307 pounds of filler. The filler is of no value to the farmer. The transportation cost of this 307 pounds must be charged against the plant foods in the mixed goods. Low-grade products are often substituted for filler. (See Cotton Enterprise for mixing table.)

Testing for Need of Nitrogen.—Yellowish color in growing corn indicates lack of nitrogen in the soil.

The diphenylamine test for nitrogen is outlined in the Purdue Bulletin 298. Average stalks are selected in a field of growing corn and tested while fresh. A solution is prepared by mixing 1.2 grams of the crystals in 4 ounces of 75 per cent concentrated sulfuric acid.

Three drops of the solution are applied on a freshly cut internode of the corn. If a dark blue color appears no nitrogen is needed. Light blue indicates some need of nitrogen. No change of color indicates much need of nitrogen.

DIPHENYLAMINE TEST FOR NITROGEN

1.2 grams crystals + 4 oz. of
75% H_2SO_4 (cp)
3 drops on Fresh-cut Internode

Dark Blue	Needs no N
Light Blue	Needs some N
No Color	Needs much N

Test live average stalks

Determining Potash Needs.—Farmers and students may study growing corn to determine its need of potash. Root-rot diseases indicate lack of potash.

The nodes or joints of growing corn stalks may be tested to determine the need of potash. The potassium thiocyanate solution test is outlined in Purdue Bulletin 298. For this test two solutions are made: Solution (a) 12 grams of the crystals in four ounces of water. Solution (b) Chemically pure hydrochloric acid ½ strength. Use fresh nodes of growing corn.

Apply five drops of solution (a).

Follow with two drops of (b).

A slight coloration shows no need of potash. Light brown indicates some need of potash. Dark brown indicates much need of potash.

Potassium Thiocyanate Test for Potash

"A"—12 grams crystals in 4 oz. water
"B"—33⅓% HCl (Muriatic Acid cp)
Apply 5 Drops Solution "A"
Follow with 2 Drops "B"
On Fresh-cut Node

Slight Coloring at node—Needs no potash

Light Brown at node—Needs some potash

Dark Brown at node—Needs much potash

Test live average stalks.
Watch immediate changes.

Testing Soils for Acidity.—As lime aids in the liberation of plant food where green manure has been turned under, the grower should be careful to avoid a sour or acid condition of the soil.

The potassium thiocyanate test is very simple. Dissolve 4 grams of potassium thiocyanate in 100 c.c. alcohol. Fill a test tube one-half inch deep with soil. Over this pour enough of the solution to fill the tube half full. Shake well and allow to settle.

If the liquid is a dark red color the soil needs much lime. Light red calls for some lime. No color shows that the soil either is neutral or contains lime. If lime is present in any soil it will effervesce when tested with dilute hydrochloric acid.

Test for Acid Soils

4 grams Potassium Thiocyanate in 100 c.c. alcohol.
Secure fair sample of soil.
Fill test tube ½ inch with soil, cover half full with solution.
Shake well and allow to settle.

(a) Dark Red—Needs Much Lime.
(b) Light Red—Needs Some Lime.
(c) No Color—Needs No Lime.

Needs of Phosphorus.—If the corn crop shows poor stem growth and does not respond when tested for nitrogen and for potash, and the soil does not show need of lime, the crop probably needs phosphorus.

Buying Fertilizers.—With the results of the test before him the farmer can buy such commercial forms of plant foods as he needs rather

than mixed goods. If there is a need for all three plant foods the farmer can buy the commercial forms of these separately through the Farm Bureau or other organizations, and mix them in the winter when outside farm work is not pressing. Organization members are given a special discount on fertilizers and the freight rate on car-lot shipments is much less than on small quantities. If the fertilizer is secured in the late fall or winter it can be put on a tight, smooth floor and mixed.

How to Mix.—Begin with the largest amount by spreading it out on the floor in a layer. Continue to build up layers until all ingredients are in one pile in layer form. In order to mix the fertilizers successfully the layers should then be cut through from the top to the bottom in small slices or sections, with shovels, throwing into another pile. Again shovel it all over to mix thoroughly. Two boys or men can mix a number of tons in a day.

Job 11. Preparing the Soil for Planting Corn. Spring Fallowing

Conditions Usually Found.—(1) Growers are paying more attention to thorough preparation before planting than formerly. (2) Those who turn under cover crops for corn usually do so at the proper time. (3) They are realizing the value of harrows in getting soils ready for planting.

Aims.—(1) Growers and students should know when and how to prepare soils for planting and to turn under green crops. (2) They should know the value of several harrowings before planting.

Problems for Study and Discussion.—(1) Why do some farmers turn their land in the fall?

2. Why should sandy soils not be turned in the fall?
3. What reason do farmers in a cold climate have for fall plowing which would not apply in a warm climate?
4. At what stage should cover crops be turned under as green manure?
5. What is the value of bare fallowing before planting?
6. Compare the weediness of two fields which were prepared in different ways before planting.
7. What are the practices in your community for preparing corn?
8. Which of these practices are sound? Why?
9. Debate winter cover crops vs. fall plowing for the South.

Fall Turning.—What is known as sod land is often plowed in the fall and left rough. This suits regions where the ground remains frozen for several months. If the soil is a clay this will (a) subject a larger surface to freezing and thawing; (b) put the soil in a better physical condition; (c) cause the soil to warm up quickly in the spring; (d) provide a reservoir for the storage of moisture; and (e) destroy a large number of insects in the winter.

Spring Plowing.—Sandy soils should not be turned in the fall because erosion and leaching will take place. Sandy soils or soils of a sandy nature should be planted to winter cover crops to provide the needed organic matter for the corn crop. These cover crops should be turned

under in the spring several weeks, if possible, in advance of planting in order (a) to provide decay of the organic matter; (b) to allow the working of beneficial bacteria; (c) to allow the destruction of insects; (d) to allow storage of moisture; and (e) to give the soil a chance to warm up before planting. (Figs. 53 and 54.)

FIG. 53.—Disking ahead of the plow. Vocational agriculture student, Clarksville High School. (H. E. Gholson, teacher.)

Plowing Under the Cover Crop.—Cover crops should be turned under at the stage when the plant food taken up by the cover crop is most widely distributed throughout the plants. This is usually when the

FIG. 54.—A speedy, thorough way of preparing corn land. Four disks drawn by tractor operated by vocational student. (F. T. Mitchell, Wilson, Ark.)

plants are getting ready to bloom and are full of plant food to put into the seed. The plants are full of moisture, have not become woody, and decay quickly when turned under. In order to hasten decomposition, the cover crop should be cut up with a disk harrow so it will mix thoroughly

with the soil (Fig. 55). Rye that has been allowed to grow too long and has not been disked to pieces may form a layer of stems between the top layer and the bottom layer of the soil and cut off the moisture from beneath. This condition sometimes causes very serious damage during a drouth.

Fig. 55.—Plowing stalk land after disking. Vocational Agriculture Department, Clarksville, Tenn.

Maintaining Bare Fallow in Spring.—Soils turned in the winter should be left rough, but as early as possible in the spring they should be gone over with a disk harrow (Fig. 56) to kill weeds, destroy

Fig. 56.—Using the cultipacker on plowed soil. Vocational agriculture student, Clarksville, Tenn.

insects, control moisture, warm up the soil and cause bacterial action. Harrowing the soil will allow the warm air and warm rains of spring to percolate into it and will get the soil to the proper temperature for germinating corn quickly. Spring plowing should be immediately fol-

lowed by disk and spike-tooth harrows (Fig. 57) in order to conserve what moisture there is and to accomplish the other ends mentioned. If the soil has been prepared early enough, bare-fallowing in spring can be practised with the disk and spike-tooth harrows until time to plant. The chief reason for cultivating corn is to control weeds. If weed seeds

Fig. 57.—Vocational agriculture student using a spike-tooth harrow in preparing soil for his corn project. He also cross-harrows young corn with this implement. Whiteville, Tenn.

can be sprouted and killed by bare-fallowing before corn is planted much labor can be saved in later cultivation, and the weeds will be destroyed before they have an opportunity to rob the soil of any moisture.

Bare-Fallowing in Spring

Sprouts and Kills Weeds
Destroys Insects
Mixes Soil with Manure
Drains Surface Soil
Conserves Moisture
Improves Seed Bed
Prevents Crust
Warms Soil
Increases Bacteria

Job 12. Planting and Fertilizing Corn

Conditions Usually Found.—(1) Farmers usually practise methods applicable to their soil and climate. (2) Many farmers do not use commercial fertilizers on corn. (3) Some good farmers use companion crops in corn.

Aims.—Students and farmers should know the methods, rates and dates of planting corn. (2) They should know how to benefit from using fertilizers. (3) They should know the effects of companion crops with corn.

Problems for Study and Discussion.—(1) Debate level vs. listing methods of planting corn.
2. Debate checking vs. drilling corn.
3. Debate soybeans vs. cowpeas, peanuts, or velvet beans in corn.
4. What methods of starting companion crops are found in your region?
5. How many farmers use nitrate of soda or other commercial fertilizers on corn?
6. Why should fertilizer not come in contact with the corn grain when it is planted?
7. Describe two good methods of planting corn.
8. How many acres of drilled corn will a bushel of shelled corn plant?
9. What advantages are there in not using the grains from tips and butts in planting?
10. How many ears of corn of average size will be required to make a bushel of shelled corn?
11. If a good stand of corn has the stalks 18 inches apart in drills and the rows 42 inches apart, how many stalks will be on an acre (43,560 sq. ft.)?
12. How many bushels of ear corn (70 lbs.) on each acre if each yields an average of one-half pound?

Activities.—(1) Overhaul corn planter and prepare it for planting to suit your conditions. (2) Conduct a trial with companion crops (soybeans) started in corn at different stages: (a) at planting time, (b) when corn is well started, (c) between rows at last cultivation.

Methods of Planting.—From the standpoint of preparation of the soil, corn is planted (1) on the level, (2) in furrows, (3) on beds and on ridges. From the standpoint of distribution of seed, corn is (1) drilled, (2) hilled, or (3) checked.

Corn can be drilled, hilled, or checked when level planting is used. Level planting should always be used where the surface of the land will justify it and where the soil is well drained. There is less labor in preparing the field and cultivation is easier. Level planting permits cross-harrowing, which cannot very well be done on ridges and on furrow-planted corn. Level planting causes corn to suffer less in case of a drouth than ridge planting.

Furrow planting is sometimes practised where there is danger of drouth. In this method corn is planted in a furrow that lies between two ridges that have been thrown up with a turning plow, disk cultivator, or lister. When the ridges are listed too high they are sometimes gone over with a section harrow in order partially to fill the furrow. This method of planting is not common. It makes cultivation very difficult when corn is small.

The ridge and the bed systems are used where the soil is not well drained and does not warm up for early planting. The bed system differs from the ridge system in that beds about eight feet wide are thrown up by back-furrowing and about two rows of corn are planted on each bed; whereas in the ridge system a single row is bedded and the corn is planted on the ridge. These systems provide some drainage, and help protect the corn from bud-worm damage because the soil warms up quickly. Corn

planted by this method suffers during a drouth, and it is usually practised only for early planting on poorly drained soils.

Spacing Corn.—Experiment stations have shown that within certain limits it does not matter much about the interval between rows nor the distance between plants in the row so long as the required number of stalks are left to produce the results desired. Drilling corn is practised more in the South than hilling, or checking. Corn is usually left one stalk to a hill rather than two or more. The ability of the soil to produce the variety that is to be planted and the use to be made of the crop largely determine the distances between rows and between plants. The usual distances between rows run from three and a half to four feet, and the spaces within the rows vary from fourteen inches on fertile soil to thirty inches on soil less fertile.

Planting dates may be classified as early or late. The early planting season in the South usually begins about March 10 and runs to May 1, depending on latitude and soil. The late season usually begins about May 10 and runs to July 1. Where in the South the uniform distribution of moisture is uncertain, it is usually best to plant early or plant both early and late. Early-planted corn may suffer from too much moisture, cold, cut worms and bud worms; but if the crop succeeds it will be resistant to summer drought. Corn planted later sometimes catches up with early-planted corn but it does not have the same resistant powers. The condition of the cover crop, the soil, the rotation, or the season may vary the time of planting on any farm.

Planting Corn.—A bushel of corn will plant eight acres of land. When soybeans or other companion crops are planted with corn, about six pounds of corn is used per acre. Single planters or two-row planters are used. Each seed hopper contains a plate with holes in it that will drop the corn in the drill at the space desired. Planters can be equipped with fertilizer drills that will regulate the amount of fertilizer to be distributed. Corn should be planted at a depth of from one to three inches. If the soil is heavy clay early-planted corn should not be covered deeply. Corn should be planted deeper in sandy soils in order that there may be enough moisture for germination.

Fertilizers for Corn.—Cottonseed meal, acid phosphate, and nitrate of soda are the commercial fertilizers usually applied to corn (Fig. 58). Where companion crops or green manures have been turned under, acid phosphate is usually applied at the rate of about 200 pounds per acre. When nitrogen is needed, cottonseed meal is used at the time of planting, or nitrate of soda is applied as a side dressing. Corn is a low-price crop

and for that reason there is a question as to how much fertilizer can be applied with profit.

Companion crops that are planted in corn in the South are soybeans, cowpeas, peanuts and velvet beans. Some of these crops are planted (1) in alternate rows, or (2) in the middle between the rows of corn at the last cultivation, or (3) in drills in the rows with the corn at planting time.

The Missouri Station found that corn or soybeans planted alone will give a larger yield than when planted with the other. But two acres of corn and soybeans planted together will furnish more grain of both than

Fig. 58.—Results of fertilizing in Arkansas, showing comparative yields of corn. Fertilizers per acre were: Left, 100 pounds nitrate of soda; center, 75 pounds sulfate of ammonia; right, "check," no treatment. (F. T. Mitchell.)

a separate acre of corn and a separate acre of soybeans. This station also found that soybeans should be drilled in corn at corn-planting time at the rate of six pounds of corn and three pounds of soybeans per acre for the best results. Soybeans planted in corn will not maintain the soil fertility, but will somewhat help it. Soybeans will decrease the yield of corn per acre by about one-fifth of the grain.

Velvet beans are quite popular as a companion crop in the Gulf States where the crop can be grown. This is a good forage crop as well as a soil builder.

Job 13. Cross-Harrowing and Cultivating Corn

Conditions Usually Found.—(1) Most farmers know that weeds and grass reduce the yield of corn. (2) Good farmers make an effort to control weeds before

they do too much damage and use suitable implements for cultivation. (3) Some cultivate to conserve moisture.

Aims.—(1) Growers should know the purposes and value of cultivating. (2) They should know how to accomplish best results.

Problems for Study and Discussion.—(1) Discuss the advantages of cross-harrowing.

2. What objections do farmers make to this practice?
3. During what times of day do farmers cross-harrow corn? Why?
4. How much other labor will cross-harrowing save?
5. What makes corn twist in hot weather?
6. How can a beginner convince himself of the value of cross-harrowing?
7. How many cross-harrowings would you make for a crop?
8. Describe the best corn cultivators for inter-row work.

Activities.—(1) Plant five kernels of corn in the top of a bottle of sand which has been well watered. Wrap a black paper around the bottle to keep out light, leaving the top open. When the corn has sprouted one inch high, slip off the paper and examine the depth of the roots. What relation has this depth to the danger of injuring the corn by cross-harrowing? (2) Plant corn in a box with wire netting in place of two sides. When the corn is twelve inches high wash the soil away from the roots and note the length of the roots and the distance from the top of the soil at which most of them are located. (3) Compare the brittleness of young corn plants (a) protected from evaporation, (b) exposed to air and sun.

The paramount purpose of cultivation is to eradicate and control weeds. Minor reasons for cultivating corn are (1) to let air into the soil, (2) to open the soil so the rainfall will go into the ground instead of running off, (3) to make the plant food in the top surface more available, and (4) to improve the physical condition of the soil (Fig. 59).

Weeds are the corn crop's greatest enemy. Weeds are voracious feeders. They use up all available plant food and drink up tons of water needed by the crop. The stations in Illinois, Virginia, and Oklahoma have conducted experiments in corn cultivation, and all agree that the dominating factor in making a success of the corn crop is not chiefly moisture conservation by making a loose mulch, but moisture and plant-food conservation by weed control. Illinois found that two plots of corn having the same seed-bed preparation but treated differently in cultivation gave wide variations in results. On one plot where weeds were allowed to grow, the average yield per acre over a nine-year period was 7.4 bushels; whereas the other plot, which had the weeds scraped off with a hoe but not otherwise cultivated, produced an average of 48.9 bushels per acre for the same period.

Saving Plant Food.—To prove that moisture conservation was not the only factor that entered into the necessity of weed control, another plot was irrigated but the weeds allowed to grow; and an average yield over a five-year period showed an increase of only 2.5 bushels per acre over the first plot. The following striking statement is made in connection with this experiment, "The logical conclusion is that the cultivated soil is of much greater value for the plant nutrients it contains than for the

moisture it may conserve." It is a known fact that the greatest amount of plant-food nutrients is found in the surface layer of the soil and it is known that corn roots feed in the upper four or five inches of the soil. Any cultivation that disturbs the corn roots so that they are incapable of taking in this available plant food is doing the crop a greater injury than if the surface were not disturbed.

Dust Mulch not Always Necessary.—The idea once prevailed that the more continuous the drouth the more frequent should be the corn cultivations; but not so. The more continuous the drouth the less

FIG. 59.—This student's corn project shows the result of thorough cultivation. (Clifford Cockran, Alabama.)

frequent the cultivation if weeds are controlled and conditions are set up that will prevent a crust. A crust on a soil is not as bad as large checks or cracks.

The Oklahoma and Virginia stations found that three shallow cultivations properly timed were sufficient when thorough seed-bed preparation had gone before, as given in Job 12.

Maintaining Good Conditions for Growth.—Thousands of weeds can be killed at a stroke with a spike-tooth harrow when their seeds are just germinating; but it may take the strength of a good man with a sharp hoe to kill one after it has grown to maturity and done untold damage.

Thorough seed-bed preparation, spring fallowing, and cross-harrowing after planting, make the problem of later cultivation a simple one.

Cross-Harrowing.—Corn should be cross-harrowed soon after planting and more than once after it sprouts above the ground (Fig. 57). Corn is brittle early in the morning, but if cross-harrowing is done later in the day it will bend and not break. The teeth of the harrow should be set at a slight angle backward so as not to accumulate trash nor uproot the corn. The teeth of the harrow get closer to the young corn than a man can with a hoe, kill many weed seeds, and save much labor.

A wide harrow covers the space occupied by four rows. As the harrow passes over the field it (1) kills what seeds there are germinating; (2)

FIG. 60.—Monroe Smith, vocational agriculture boy, Christiana, Tenn., cultivating his Nitrate of Soda Contest corn project.

brings up to the surface those lying dormant; (3) kills insects; (4) warms the soil; (5) provides air spaces in the soil; (6) conserves moisture; (7) opens up the soil and makes it capable of taking in more rain; (8) aids roots in getting their plant food; and (9) assists in unlocking plant food.

When corn becomes so large that the cross bars of the section or drag harrow will break down the corn, then is time to quit harrowing and use the cultivator.

Cultivating.—Since weed control is the primary purpose of cultivating and corn roots do most of their feeding within the upper four or five inches of the soil, cultivation should always be shallow unless the soil has a tendency to run together after a hard rain. If any deep cultivation is to be done, it should be done in the early stages of the crop. (Fig. 60.) The shovels on the cultivators should be narrow, and they

should be run close to the corn. All later cultivation should be shallow (Fig. 61).

Choosing the Cultivator.—The type of cultivator to use can best be determined by the farmer if he knows what conditions he needs

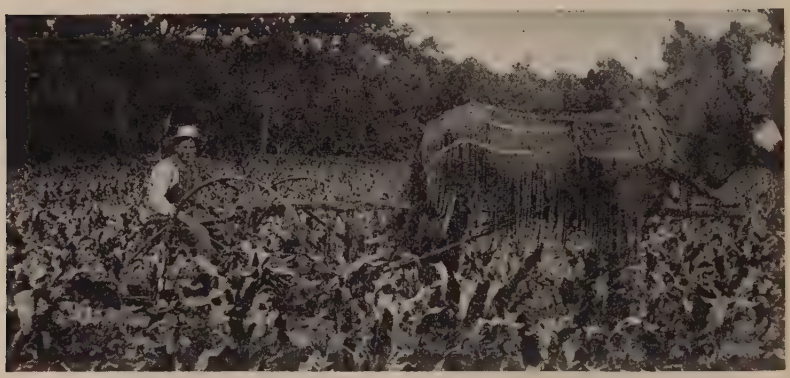

FIG. 61.—Vocational agriculture student of the St. George, Kansas, rural high school, cultivating his corn project. (Earl Knepp, teacher.)

FIG. 62.—Cultivating corn with a tractor. Soil is well pulverized. Two or more rows are cultivated at once and many acres are tilled in a day. (F. T. Mitchell, Wilson, Ark.)

in the soil. Spring-tooth cultivators that can be adjusted are gaining in popularity among farmers who use one-horse implements. The same kind of cultivator teeth can be had for riding implements. Common hoe shovels are most popular. Disk cultivators need to be put into the

hands of skilled operators in order not to cut the roots too much. Tractor cultivators usually cover two or more rows (Fig. 62).

Job 14. Controlling Enemies of Corn

Conditions Usually Found.—(1) The corn crop is seldom ruined by enemies. (2) Certain insects and other enemies are worse in some sections than in others.

Aims.—(1) Corn growers should know what enemies attack corn. (2) They should know something of the habits of these and how to control them.

Problems for Study and Discussion.—(1) Describe the work of cutworms; of root worms.

2. Tell of suitable remedies for each of these two insects.
3. Describe the work of corn ear worms and give measures for their control.
4. Of what injury are corn root aphids? How controlled?
5. Discuss the methods of attack of European corn borers, and remedies for them.
6. How should we fight army worms? Chinch bugs?
7. What is the damage done by rough-headed corn stalk beetles? Give remedies.
8. Discuss the way each disease affects the corn plant.
9. How can corn seed be treated to prevent its being eaten by ground squirrels?

Activities.—The students should bring in specimens of insects and diseases on corn. Preserve good specimens in five per cent formalin. Label them all and use them in reviewing your studies of enemies.

Classification of Enemies.—All enemies of corn may be classified into (1) insects, (2) fungous diseases, (3) animals and birds.

The insects commonly found attacking corn are (1) cutworms, (2) corn ear worms, (3) corn root worms, (4) European corn borers, (5) grain moths, (6) corn stalk borers, (7) chinch bugs, (8) corn root aphids, (9) army worms, (10) grasshoppers, (11) weevils, (12) rough-headed corn stalk beetles.

The diseases most common to corn are root rot and smut.

The animals and birds that bother corn are squirrels, raccoons, blackbirds, crows, moles, gophers, and prairie dogs.

Cutworms are smooth, gray and brown in color. They hatch from eggs laid by brownish moths late in summer. They pass the winter as caterpillars, and appear early in the spring and do much damage to corn by cutting it off just above the ground. They work at night and hide just under the surface of the soil near the point of the damage they have done.

Control.—Disking the plowed land and spring-fallowing with a drag harrow will warm up the soil and cause worms to transform into the pupa stage early. One pound of Paris green to 200 pounds of bran dampened with water that has been sweetened with molasses to cause the worms to eat it will kill them if placed near the corn plants.

Corn ear worms are of several colors, depending on the age. They vary from a light green to a dark brown. The eggs are deposited singly on the silks of corn about dusk by a fawn-colored moth. The tiny worms eat their way down the silks onto the ear. The worms eat many things, even each other.

There are about five generations of the moths. They pass the winter in the pupa stage.

They can be controlled by trap crops and by poisoning. They feed on vetch, peas, cotton, and other plants. One of these crops planted near by may keep some of them away from the corn. They can be killed by spraying or dusting with arsenate of lead or Paris green several times during the growing season.

Corn root worms come from eggs laid by green-marked twelve-spotted cucumber beetles. They attack beans, melons and corn. They bore into the roots of young corn and in boring out ruin the buds. Because the damage to the bud seems to be more than the damage to the roots, they are sometimes called "budworms." The beetles hibernate over winter, appearing as early as March in the southern states. The eggs are laid singly just beneath the surface of the soil and hatch in about ten days.

Rotation of crops or heavy seeding of grain may be used as measures of control. Late planting may help.

European corn borers come from yellow moths that fly by night and lay eggs producing worms that have almost caused a panic in some parts of the corn belt. These moths lay their eggs on the under sides of the leaves, and the larvae bore down into the stalks, eat the pith out, cause the stalks to break over, and there, on the inside of the stalks, these borers spend the winter. Whenever the borers invade a field the tassels drop over as if they had been broken, and the stalks drop over and break. The caterpillars are brownish, black-dotted, dark-headed. They have the power of eating through cardboard boxes and even into fence posts. They have been known to bore through cork stoppers and get out of bottles. They have been submerged for a month in an ice cold brook, and most of them came out alive. One of the moths has been known to lay as many as one thousand eggs within two weeks. The moths may fly from five to twenty miles.

Control is almost impossible, as the borers get inside the corn stalks in two days after they are hatched. This terrible enemy to corn is being combated and controlled by cutting the stalks low, and hauling them to a pulp mill where stalks are made into wall paper. It is being controlled by shredding and burning the stalks and by clean plowing. Fence rows should be cleaned out and weeds and trash burned. Putting corn fodder into silos destroys these borers. Rotation of crops will aid in their destruction.

The larger corn stalk borers are large white brown-spotted caterpillars which bore into the hearts of the young stalks early in the spring and are also called "budworms." They hollow out the stalks, which break off or are blown over by the wind. The caterpillars burrow into the tap roots of corn when they become full grown and there pass the winter. The moths emerge from the pupa cases, which form early in the spring, and lay their eggs on the leaves as do the European borers.

Control.—Burning all stalks and rotating crops help control these borers.

Chinch bugs have black bodies and white wings. They are seldom serious in any of the southern states except Oklahoma and western Texas. During the

winter the bugs hibernate in clumps of grass, in old shocks of corn, or in any trash that may be around. These insects spread from field to field by crawling before the wings are developed.

Control.—Burning-over grass land and fence rows in the fall will destroy a large number of them. Burning corn stalks or turning them under will control some of them. If a furrow is plowed around the corn field in early summer, with the straight side of the furrow next to the field, many of the bugs will be killed in the dust. If post holes are dug every few feet in the furrow, the

FIG. 63.—Chinch bugs on corn project, Moorehead, Miss. Agriculture teacher advised student how to control bugs.

control will be most effective. Coal oil sprayed on the bugs will kill them. A tar line poured around a field is also effective. The Kansas station recommends a plan of digging post holes along the tar line and putting calcium cyanide in the holes. Radiating tar lines are run out from each hole to prevent the chinch bugs from passing the holes (Figs. 63 and 64).

Corn Root Aphids.—When corn does not grow but turns yellow and fails to show vigor, the presence of corn root aphids may be suspected. When they cluster on the roots of corn they are bluish-green in color and have a waxy bloom. When corn is planted year after year on the same soil the root aphids are liable to attack the crop. Small brown ants usually found in corn fields

care for them over winter for the honey dew they give off. As soon as spring comes the ants bring the aphids to the plant roots that have been laid bare for them by the ants. All summer long the ants burrow around the roots of corn and carry the lice from plant to plant so more honey dew will be made for them. These aphids reproduce very rapidly. An aphis will mature and give birth to young in about eight days after it is born.

Control.—Rotation of crops and destruction of ants by deep plowing are the best methods of control. Fertilization of the crop helps.

Army Worms.—Because one female moth of this species may lay over 700 eggs that hatch in ten days it does not take long for the progeny of one moth to make a destructive army. The worms usually feed only at night and often whole fields are ruined before they are discovered. They appear somewhat periodically, because in some years they are not affected by their natural

FIG. 64.—Vocational agriculture students in Miltonvale, Kansas, rural high school, constructing a chinch-bug barrier to prevent chinch bugs from invading an adjacent corn field. (Lester J. Schmutz, teacher.)

enemies, whereas in other years natural enemies and the efforts of man reduce them greatly. They go *en masse* and eat leaves of the crop. When they become grown, in about four weeks after hatching, the worms drop off the plant, go into the ground, pupate and emerge as adult moths in about two weeks. These produce another destructive army of worms. There may be as many as six generations in the South in one year.

Control.—Army worms have natural enemies to help keep them under control. The tachina flies lay eggs on the bodies of the caterpillars, and when they hatch the maggots eat into the worms and kill them. There are ground beetles that feed on them. They can also be controlled by spraying or dusting with Paris green or arsenate of lead. The furrows referred to as a means of controlling chinch bugs may help control army worms when marching.

Rough-headed corn stalk beetles are about one-half inch long, hard-shelled and very black. They are confined entirely to the southern states.

The beetles injure the corn by boring into the outer walls of the stalks as soon as the plants come up. They continue this attack until the corn is knee high. They cut the heart out of the corn plants, and the plants wither and drop over.

The beetle lays a single egg which hatches into a grub, then goes into the pupa, and finally into the beetle. It hibernates in the beetle stage and is ready to begin its damage as soon as corn comes up in the spring. This beetle is found around low, uncultivated, poorly-drained fields. When old fields are planted to corn the crop will show the effects of the attacks of many beetles.

The best method of control is to keep cultivated all land where corn is to be planted. Also keep land well drained. If there is an old pasture that is to be cultivated it should not be put in corn the first year. Other measures of control: (1) pasture old land with hogs to destroy the grubs, (2) plant corn early, (3) lengthen rotation, (4) fertilize corn, (5) hand-pick the beetles.

Grasshoppers are often very bad in dry regions. They move from field to field, rapidly destroying crops as they go. When very numerous they may be destroyed in meadows and pastures by use of a hopper doser. (See tobacco enterprise.)

Diseases.—Corn root rot and corn smut are the two worst diseases that affect corn. Root rot is controlled by breeding and selecting resistant seed. The disease is often more serious on soils deficient in potash.

Corn smut attacks the stalk, the tassel, and the ear. It causes enlargements of the parts affected. This part is green at first and as the spores mature the mass turns black. The enlargement bursts and the wind scatters the spores over the field. The best means of control is rotation of crops. Care in the application of manures is another precaution. Smut spores will live in the soil, and if corn follows corn the second year the smut is liable to be worse.

Other Enemies.—Ground squirrels sometimes eat the corn seed after it is planted. Seed corn treated with a coat of tar, turpentine or castor oil is distasteful to ground squirrels, gophers, crows, and blackbirds, and they are not likely to bother fields when the seed corn has been treated before planting. Shell the corn and mix thin tar and gasoline or other repellant with the seed, stirring it until all kernels are coated.

Corn that is planted near woods or wooded swamps is liable to be attacked by squirrels and raccoons. There is no control of these animals unless the farmer and sportsmen kill them with guns and dogs.

Job 15. Making Corn Silage

Conditions Usually Found.—(1) Successful dairy farmers make and feed silage. (2) Beef cattle are sometimes fed silage. (3) Some silos are abandoned.

Aims.—(1) Young farmers should know how to plant corn for silage. (2) They should know at what stage to make corn into silage; the kinds of silos; their values; and how to fill them.

Problems for Study and Discussion.—(1) Report on the number of filled and unfilled silos in your community.

2. Why have the unused ones been abandoned?
3. Report on the crops that are put into silos.
4. What use is made of the silage?

5. How many tons of silage are required to fill different silos in your community?
6. How many acres must be planted to corn to fill a 100-ton silo?
7. How many dairy cows will this silo feed?
8. Calculate the complete cost of this silage after it is made.
9. What is the capacity of a silo that is 32 feet high and 16 feet in diameter?
10. How many cows will this feed at the rate of forty pounds of silage per day?
11. Debate binder-cutting vs. hand-cutting; vs. sled-cutting.

The Value of Silage.—Cows that produce milk demand succulent foods in order to keep up the milk flow. There is no better way of preserving corn in its succulent stage than to make silage of it. Other crops, like soybeans, cowpeas, sorghum and velvet beans, may be preserved in a similar manner. Silage will (1) stimulate milk flow, (2) keep livestock in thrifty condition at all times, (3) help young stock to winter without much loss of flesh, (4) make it possible for a farmer to keep a large number of animals on small acreages, and (5) take the place of pasture during dry periods.

Corn planted for silage is usually planted thicker in the drill and with rows closer together than corn planted for grain. Corn planted in rows three feet apart and from eight to twelve inches in the drill should make good silage, and prolific varieties with small stalks and many leaves make the best. (See Job 4). Soybeans are sometimes planted in corn for silage. The Storrs Station found that more green and dry matter are produced per acre when the two are drilled together; and that the nutritive ratio of the silage is narrow enough to require 300 pounds of 40 per cent cottonseed meal to supply the protein added by the use of soybeans from one acre. Soybeans may be drilled in the corn with a special plate on the planter at the time the corn is planted. The drill should drop at the rate of three soybean seeds to one of corn every twelve inches.

Silo Regions.—The percentages of silage produced in different sections are reported by the United States census as follows:

	Per Cent
New England	4.1
Middle Atlantic	17.3
Central	70.1
South Atlantic & Southern	5.4
Mountain	1.3
Pacific	1.8

The corn belt states naturally show the greater tonnage of silage, corn being the principal silage crop.

When to Cut Corn.—Corn passes from the milk stage to the dough stage and then to the hard and mealy stage. The longer corn can be

allowed to remain standing without the stalk dying, drying up or becoming frost bitten, the better it is for silage, as the amount of dry matter rapidly increases from the glazing stage to maturity. It is not often that cold weather catches early corn in the South. When it does, corn immediately cut can be put into the silo to an advantage. If soybeans are planted in corn for silage the variety should be grown that will be ready to go into the silo when the corn is ready. Experienced farmers, teachers of vocational agriculture or county agents may be able to name such a variety.

Cutting Corn.—If a farmer has a silo and fills it each year it might pay him to own a binder in coöperation with neighbors. One corn binder (Fig. 65) is able to cut corn about as fast as a 14-inch silage cutter can

FIG. 65.—Harvesting corn with a binder. Three mules are used because of heavy draft. One row is cut at a time. Some stalks are missed if blown over by the wind. (F. T. Mitchell, Wilson, Ark.)

handle it. There is usually no interruption if the binder begins work a few hours before the cutter begins to operate.

The usual practice in the South is to cut by hand or by sled. The sled is described in Job 18. One horse and two men can cut two rows at a time when a sled is used. The sled method or hand cutting is economical for most farmers. Depreciation, cost of operating, and the very few days a binder is in use are conditions which seldom justify a farmer in owning a binder individually.

The secret of good silage is excluding the air and keeping it packed tight enough at all times. If there is plenty of moisture in the corn, or if water is added to the corn as it is cut, the air will be excluded. The side walls and bottom of the silo should be water-tight. The sides should be smooth so that the silage will pack down. If air is admitted to the silo to any great depth, the silage will spoil and molds will form that are

poisonous to livestock. Good silage is made by the action of bacteria that work without the presence of air. Tight, smooth side walls, tight bottom, plenty of moisture and good packing at filling time are the conditions essential to a good product.

Making Silage.—When the corn is brought from the field, it is fed into a silage cutter that has connected to it a fan which blows the silage through an elevator into the silo at the top (Fig. 66). One or two men usually work on the inside of the silo to pack the silage around the outside walls of the silo. When moisture is needed, it is poured into the

FIG. 66.—Making silage of corn. Stalks and ears are hauled to the cutter, which is kept busy cutting and blowing the feed up into the silo. A man inside spreads and tramps the silage. When the silo is full the top is "sealed" by soaking a bushel of oats and spreading it on top to sprout. (Int. Harv. Co.)

cutter and is blown into the silo at the time of the silage, or it may be run into the silo with a hose.

The kinds of silos used are, (1) pit, (2) wooden stave, (3) cement block, (4) galvanized iron, (5) brick, (6) hollow tile, and (7) concrete. All of these are mostly above the surface of the ground except the pit silo, which may be a hole or a trench in the ground. In order that any silo may function as it should it must (1) not leak, (2) be able to withstand pressure from within, and (3) have smooth inside walls. The stave silos make sweet silage but they get loose and fall to pieces when empty. The concrete and similarly constructed silos may not always produce the sweetest silage but they have the endurance needed. Every silo should be repainted or tarred inside each year before being filled.

Approximate Capacity of Cylindrical Silos for Well-Matured Corn Silage, in Tons
(King)

Depth of Silo, Feet	Inside Diameter of Silo, Feet					
	12	14	15	16	18	20
20	38	51	59	67	85	105
22	43	59	67	77	97	120
24	49	66	76	87	110	135
26	55	74	85	97	123	152
28	61	83	95	108	137	169
30	68	93	105	119	151	187
32	73	101	115	131	166	205
36	105	130	140	155	190	235
40	121	150	165	180	228	279

Job 16. Making Fodder and Harvesting Ears

Conditions Usually Found.—(1) Good farmers do not "pull fodder." (2) Successful farmers make fodder from the entire corn plant. (3) Methods of harvesting ears vary much throughout the South.

Aims.—(1) Students should know the harmful effect of pulling fodder or cutting the tops out of the growing corn. (2) They should know good practices used in making fodder and harvesting ears.

Problems for Study and Discussion.—(1) Describe a husking pin and its use.
2. Debate snapping ears vs. cutting corn for fodder.
3. List the methods of harvesting and tell which method you think best. Why?
4. Find how many farmers pull fodder and how many cut tops.
5. Find how many farmers snap corn and how many husk corn in the field.
6. What farmers cut whole stalks and husk ears from stalks?
7. When is husking done?
8. What is stover?
9. During what time of year do livestock like fodder best?
10. What are the local practices in time of feeding fodder?

Harvesting Corn.—The methods used in harvesting corn are (1) snapping the ears with the husk left on the ears, (2) snapping the ear and husking at the same time, (3) cutting the whole stalk and shocking (Fig. 67), later husking the ears from the shock, (4) cutting the whole stalk and husking the ears with a shredder, (5) hogging-down corn or harvesting with other livestock.

Fodder is made by (1) stripping the leaves from the green stalks and leaving the ears, (2) cutting the tops out of the corn above the ears, (3) cutting whole stalks and curing in shocks.

Snapping the ears with the husk left on is practised in many parts of the South. In some sections the ears are snapped from the stalks and thrown in heap rows to be later taken up by a wagon. This is a poor practice as it involves much labor and causes loss by mold and rot. When

snapping is done the corn should be thrown directly into the wagon. Two men can carry two rows on each side of the wagon and the "down" row. The "down" row is the row that the wagon passes over while

FIG. 67.—Student cutting corn by hand. This method is a little slower than when a corn binder is used, but it saves the horse labor and saves purchasing the machine.
FIG. 68.—A wheel-cutter cuts two rows at a time and is drawn by one horse. The fodder is laid in piles to be hauled for silage or to be put in shocks to cure.

harvesting is being done. On hillsides and elsewhere it is a good practice to have a "throw" board on one side of the wagon. When the throw board is used, harvesting can take place from only one side of the wagon. The throw board is a board placed above the sideboards of the wagon on one

side of it to prevent the corn being thrown over the wagon. The end gate of the wagon should be so constructed as to let down and form a platform when unloading is being done. This platform allows the use of the corn scoop, which greatly hastens unloading.

Cutting the whole stalk is done by means of a corn knife, by a corn binder, or by a sled. The binder has been discussed under Job 17.

A sled or wheel cutter (Fig. 68) can be made at home by riveting a heavy scythe blade to each side of a sled and attaching iron rods shaped into hooks in order that the corn will be gathered into the scythe blades. The operator catches the corn as it is cut until he has an armful and then the horse is stopped and the corn is put in a shock. Two men can keep the sled moving, and cut two rows and shock the fodder as fast as a binder can cut one row.

Shocking.—Corn is shocked at the rate of about 200 stalks to a shock and the shock rows are from ten to twenty rows apart depending upon the heaviness of the corn, and the climatic moisture. A shocking-horse is a good thing to use. The shocks are tied together with binder twine. Before they are tied it is a good idea to tighten them by drawing them together with a rope having an iron ring tied in one end.

"Pulling fodder" is a very bad practice and is not used very much. It is disagreeable work, it involves an unusual amount of labor. About 500 or 600 pounds of dry fodder is all that can be expected from an acre. A man can more profitably use his time curing hay. A loss of about 20 per cent of grain is the result of such a practice. Cutting out the tops is almost as bad as pulling fodder, and the practice has about the same disadvantage.

Grazing Stalks.—Where there are a number of cattle on the farm to graze the fodder from the standing stalks, it is not a very bad practice to snap the ears and graze the standing fodder. However, the land cannot be immediately used for other crops.

If the corn is cut and shocked, (1) the land is immediately available for seeding winter grains; (2) all of the corn plant is saved; (3) the land is easy to work because of freedom from stalks; (4) it is possible to harvest the crop by machinery; and (5) many insects are destroyed.

Job 17. Harvesting with Livestock

Conditions Usually Found.—(1) Hogs are used more than other livestock for harvesting corn. (2) More farmers would hog-down the corn crop if fields were adequately fenced and could be supplied with water. (3) Some farmers "hog-off" the corn because labor is scarce.

Aims.—Growers should know the advantages and disadvantages of "hogging-off" the corn crop; when to begin this; whether to use companion crops; when to use supplementary feeds and mineral mixtures.

Problems for Study and Discussion.—(1) To what extent do farmers in your community "hog-off" or harvest with livestock?
2. What disadvantage is there in putting small pigs alone in a corn field?
3. What should be the weight and condition of hogs turned on corn?
4. Debate, corn plus tankage vs. corn plus soybeans; corn "hogged-off" in both cases.
5. Debate, "hogging-off" corn vs. harvesting and feeding.
6. How long would it take fifty hogs averaging 100 pounds to "clean up" a twenty-acre corn field that averages 35 bushels per acre?
7. How much of the field should be open to these hogs at one time?
8. Debate, turning in on green corn vs. turning in on corn when about mature.

Activities.—Make trials to compare practices regarding the areas which should be open to livestock at any one time.

Advantages and Disadvantages of "Hogging-off" Corn.—The most outstanding argument in favor of "hogging-off" corn is the saving of labor by the farmer who is operating a larger farm than he is able to get labor to handle. Along with this great argument may be coupled saving of manure and providing sanitary quarters for the hogs. The most outstanding disadvantage is that the farmer who "hogs-off" all his corn is using his corn and is forced to sell his hogs regardless of the price. "Hogging-off" all corn makes the farmer sell his hogs at the time a large number of hogs are coming on the market. The price is likely to be lower than at other seasons.

Practices Followed.—Some farmers plant an early-maturing variety of corn in order that the hogs may get on the crop early. Unless the price is good, this is hardly an advantage, as the yield of the early-maturing variety is less, and the price will not often make up for the loss in yield as compared to the regular variety.

If the hogs are turned into the corn crop when it is too green there is a danger of scouring the hogs. There is a rapid development of dry matter in corn from the silage stage to maturity. If the farmer is planning to hog-down any of his corn he should plan his operations so his corn will be ready for his hogs and his hogs ready for the corn.

Experiment station records show that pigs that have good frames, are thrifty, but not too fat, and weigh from 75 to 100 pounds each make the most economical gains when turned on a corn field. The farmer must plan his breeding dates and planting dates so his pigs and corn will be ready for each other. Not only must operations be planned so that the crops and animals will be ready, but the farmer must also plan to have enough corn for his pigs. If he knows about what yield to expect from his corn, he can figure that ten pigs, from 75 to 100 pounds in weight, will clean up an acre in as many days as there are bushels per acre.

If he has ten pigs on one acre of corn and the yield is 35 bushels per acre, he can reasonably expect this to last 35 days. Pigs should not be turned in on corn while it is too green, but they should be turned in on the

field so it will be cleaned up before severe weather sets in. Except for rain and mud the pigs can remain in the corn field all winter in the South (Fig. 69).

Fig. 69.—Hogs and other livestock are often fed in cornfields to save the labor of harvesting by other methods. Some corn is wasted by this method except under skilful management. (Int. Harv. Co.)

Time Required by Pigs to Harvest an Acre of Corn *

	Standing Corn Only			Standing Corn and Soybeans			Standing Corn and Soybeans Plus Minerals			Standing Corn Plus Tankage		
	Yields, Bushels per Acre											
	35	50	65	35	50	65	35	50	65	35	50	65
	Days											
10 shotes 75–100 lbs.	43	61	79	33	47	62	29	42	54	34	48	62
10 shotes 100–150 lbs.	21	41	53	25	36	47	23	33	43	25	36	47
20 shotes 75–100 lbs.	21	30	40	17	24	31	15	21	27	17	24	31
20 shotes 100–150 lbs.	14	20	27	13	18	24	12	16	21	13	18	23
40 shotes 75–100 lbs.	11	15	20	8	12	15	7	10	14	8	12	16
40 shotes 100–150 lbs.	7	10	13	6	9	12	6	8	11	6	9	12

* Ohio Bulletin 398.

Soybeans in Corn.—The stations of Ohio and Missouri have studied the value of soybeans in corn from the standpoint of supplying the protein needed. They found that soybeans did not take the place of tankage. Tankage is better than the soybeans. Hogs turned on corn without

soybeans and fed dry tankage make cheaper gains than hogs on corn and soybeans without tankage. Soybeans and corn produce better results than corn alone; but soybeans will not take the place of tankage. Soybeans grown in corn reduce the yield of corn. Hogs that are on corn and have access to green pasture like rape, rye, clover, or alfalfa, will do better than on any other combination. If tankage is fed dry to hogs when corn is being hogged down, the increased return per bushel of corn is 30 cents when hogs are worth $8.50 per hundred.

Job 18. Storing and Marketing the Crop

Conditions Usually Found.—(1) Most farmers store their corn properly. (2) A few allow corn to become damaged in the field. (3) A few do not have special cribs. (4) Most of the corn crop is marketed through livestock. (5) Some farmers do not have storage facilities and have to sell from the field. (6) Corn prices change much within a year. (7) Good farmers keep up with the market and know when to sell.

Aims.—Growers and students should know (1) the proper conditions for storing corn; (2) how to construct proper storage cribs; (3) how to study market reports; (4) conditions that will help them to decide how to sell; (5) under what conditions the farmer can afford to sell his crop direct and under which he should feed it.

Problems for Study and Discussion.—(1) Why should corn not be put in the crib as soon as it is put in the shock?

2. Why do farmers usually wait until after the first killing frost to gather corn?
3. Why is it better to crib corn on a cold, clear, windy day than on a foggy, misty day?
4. Why do some farmers have two cribs for their corn?
5. Why is a crib sometimes built narrower at the bottom than at the top?
6. Why should a crib not be over eight or ten feet wide?
7. Calculate the size of a crib necessary to hold the corn from a forty-acre field that averages thirty-five bushels per acre.
8. How much is a "barrel" of corn?
9. How can a corn crib be made rat-proof?
10. What advantage has the farmer with adequate storage space over the farmer without?
11. What is the usual relation between the price of corn and the price of hogs?
12. Compare the price curves of hogs and of corn in December over a ten-year period.
13. Under what conditions will it pay to sell green corn as roasting ears? (Fig. 70.)
14. What must the farmer know before he can decide whether to feed his corn to hogs or sell directly?

Activities.—Make price curves for hogs and for corn for each month over a five-year period. The curves may be drawn on a wall chart, using black for corn and red for hogs.

Conditions for Storage.—When corn is cut and shocked the ears usually contain moisture to the extent of one-third or one-fourth of the weight of the corn. If the corn is put in a crib under such conditions it will mold and rot. It is necessary to put it in shocks and leave it for some time before storage or shipping. Farmers who snap the corn from the standing stalks usually wait until it is dry, as it is hauled immediately to the crib.

A dry, clear, windy day is best for putting corn in the crib, as the husks and grain are dry; and there is less danger from mold or rot if there is adequate ventilation.

Good Cribs.—To protect from fire, cribs are usually built away from the main barn to store the major part of the crop. Small feed cribs are built in or near the barn to facilitate feeding. The crib construction should provide adequate ventilation and protection from mice, moths, and weevils. Cribs should never be built wider than eight or ten feet, as a greater width may cause the corn to heat. Cribs should be located in open spaces. They should be wider at the top than at the bottom in order to

FIG. 70.—This student found roasting ears a good form in which to market corn from his project.

afford protection to the corn from rain. Cribs should be slatted, with the slats nailed on the inside. Heavy screen wire nailed on the slats will protect the corn from mice. Temporary wire cribs are often used for holding a short period (see figure in alfalfa enterprise), for corn on the cob.

To find the capacity of a crib in bushels, find the number of cubic feet in the crib and multiply by two-fifths, or multiply by four and point off one place to the left. A bushel of ear corn in shuck weighs about seventy pounds after it is dry.

Deciding How and When to Sell.—In order to decide intelligently how or when to sell his corn crop a farmer must know the daily prices of corn and hogs by radio, newspaper reports, and stock-yard

bulletins. In addition to this information he should read forecasts and crop and market reports issued by the U. S. Bureau of Economics.

There are other things that make a farmer decide what to do with his corn crop. His crib space may not be adequate, his capital may be limited, and rather than insure or take the risk of loss by fire, rot, and mold, he may be forced to sell.

Shipping corn before it is well cured is dangerous. Hauling in the fall is also a job which requires much labor and may be more easily performed in mid-winter, when other farm work is not pressing. Cars for shipment are more easily secured after the rush is over.

Relation of Prices of Corn and Livestock.—If corn is relatively low in price and farm animals are selling so that he can get even a little better price by feeding, he can afford to market his crop through livestock, if he has them, for the benefit of the manure to his land. An average of

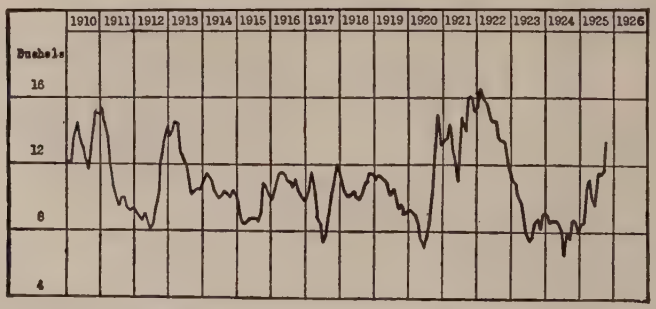

FIG. 71.—The number of bushels of corn that 100 pounds of live weight of hogs would pay for, based on average farm prices for corn and hogs each month of the year. When hogs are scarce and corn is plentiful the ratio becomes more favorable for hog feeders.

400 to 500 pounds of corn will produce 100 pounds gain in live weight of hogs. This is reduced when tankage is fed in connection.

Every farmer must decide by working out his problem whether he can afford to sell his corn through livestock. When corn is selling at one dollar per bushel, hogs should usually sell at ten cents per pound to justify the farmer in marketing his corn crop through them (Fig. 71).

Coöperative Shipping and Selling.—When several farmers or all the farmers coöperate with each other, many of the above problems are more easily solved. Mills and elevators of the region usually will pay better prices where farmers are closely bound together or where most of the crop has been pooled by the growers.

Grades of corn for white, yellow, and mixed have been established:

Nos. 1, 2, 3, 4, 5, 6 and "Sample." The federal standards for the six main grades are here given in table form.

Grade No.	Minimum Test Weight per Bushel	Maximum Limits of			
		Moisture	Foreign Material and Cracked Corn	Damaged Corn	
				Total	Heat Damage
	Lbs.	%	%	%	%
1	55	14.0	2	2	.0
2	53	15.5	3	4	0.1
3	51	17.5	4	6	0.3
4	49	19.5	5	8	0.5
5	47	21.5	6	10	1.0
6	44	23.0	7	15	3.0

Things to Make at Home.—Bushel crate, corn seed rack, corn crib, seed-tester box, side boards for corn wagon. Ask farmers for suggestions regarding things to make to aid in the corn enterprise.

SMALL-GRAIN ENTERPRISE

By E. B. Matthew, A.B., M.S.

Arkansas State Supervisor Agricultural Education

Analysis into Jobs.—The following eighteen jobs include the main teaching units in the small-grain enterprise. References are to U. S. Farmers' Bulletins. See also *The Small Grains* by Carleton.

1. Determining possibilities with small grains. 756, 885, 894.
2. Choosing the crop and variety. 436, 786, 892, 1119.
3. Deciding acreage, soil, and field.
4. Securing, cleaning, and testing seed.
5. Providing organic matter.
6. Buying and mixing fertilizer.
7. Liming the soil. 921.
8. Preparing the seed bed.
9. Treating grain for smut. 939.
10. Sowing seed and applying fertilizers.
11. Sowing legumes with small grains. 515, 693, 1143, 1339.
12. Controlling grain enemies. 1083.
13. Harvesting the crop.
14. Threshing grain.
15. Storing the grain.
16. Using the straw.
17. Marketing and using grain.
18. Keeping records and accounts. 511, 572, 782, 1182.

Job 1. Determining Possibilities with Small Grains

Conditions Usually Found.—(1) Wheat is grown only to a limited extent in the South. It is grown primarily as a money crop. (2) Oats and rye are grown for feed, cover crops, and only to a limited extent as cash crops. (3) Barley is grown only on a small scale, for winter pasture and for threshing. (4) Rye and oats are sown in the South as nurse crops for clover, vetch, and other legumes. (5) Rye is frequently used as a green manure crop. (6) Rye and oats are sometimes sown in combination with legumes for hay and winter pasture.

Aims.—Consideration should be given to all the factors affecting the growing of small grain in the locality in which the student lives.

Problems for Study and Discussion.—(1) How does the yield of small grains in the South compare with that of the United States as a whole?

2. How does the cost of growing wheat and other small grains in the South compare with the production costs elsewhere?
3. Find whether climate and soil of your region are suitable for growing these crops.
4. To what degree are harvesters, threshing machines and other implements available?
5. Is it desirable to grow the small grains for a cash crop, or for pasture, hay, cover, or nurse crop?

6. Of what value is the straw for roughage and bedding?
7. Which of the crops is best adapted to the soil and climate of your region?
8. How would a small-grain crop fit into local rotations?
9. What disposition would be made of the crop if grown?
10. What are the diseases and insect enemies of small grains in your locality?
11. What other countries of the world have an influence on small grain prices?
12. Consider all factors, and decide the possibilities in growing a small grain crop with profit in your community. Give reasons.

Activities.—Graph the yields of each of these grain crops for several years.

Wheat and Other Small Grains.—From prehistoric times wheat has been a staple crop for human food. It is grown more widely than any other crop. The United States raises more of this crop than can be consumed by our people and exports the surplus. Other wheat-raising countries are Australia, Northern Europe, and Argentina. The surplus from these countries affects the world price, and consequently the price received in this country. The average production of wheat in the United States over a series of years has been found to be 14.5 bushels per acre. In the cotton belt the average yield is one and a half to two bushels per acre less. The cost of growing an acre of wheat in the South is usually greater than in special wheat sections, on account of the low yields due to scab, rust and other enemies, sizes of fields, the machinery used, and the soil conditions.

Clay or loam soils, with considerable lime, are considered best for wheat. Rye and oats may be grown on less productive soils than wheat.

The average yield of oats and rye for the southern states is, like that of wheat, less than for the United States as a whole. Oats and rye are grown for grain, for hay, for a winter cover crop, a nurse or companion crop, for winter pasture and for green manure. Many of the best farmers consider a small-grain crop necessary in a crop rotation. The grain crop is usually sown in the fall and thus, by covering the ground in the winter months, prevents erosion or washing of the soil. To a certain extent it can be used as winter pasture. In the spring it is cut for hay, or harvested for grain, and in the same season followed by soybeans or cowpeas, so that the same soil yields two crops in a single year. It is these double-cropping and soil-conserving features that make small grain raising desirable in the South, even when the yield per acre is not as great as in other sections. By a proper combination of small grains with legumes in the farming system, it is possible to have a winter cover crop each year and thus reduce to a minimum the washing of the land and loss of fertilizer elements through leaching.

Uses of Small Grains.—Wheat is grown in the South principally for home use and as a cash crop, and sold to mills to be made up into flour for human consumption. The by-products, as shorts and bran, are used for

livestock and poultry feeds. An increasingly large amount of wheat is used in the poultry grain ration.

Oats are used principally for feeding livestock. Practically all of the rye threshed is used for reseeding. Both oats and rye are cut for hay when not grown for grain, and frequently are combined with winter vetch for a combination legume-and-grass hay. The average hay production is about one ton per acre.

Insect and Disease Enemies.—In making a decision on the growing of small grain, consideration should be given to the effects of insects and diseases on the crop. The Hessian fly is injurious to small grain in certain sections, and rust, scab and smut are common diseases in the South. Investigation should be made of the prevalence of these enemies and to what extent they can be controlled.

Job 2. Choosing the Crop and Variety

Conditions Usually Found.—(1) Wheat and other small grains are seldom major crops in the South. (2) The acreage is limited. (3) Wheat and rye are sown in the fall, while oats may be sown in either fall or spring, depending upon the latitude and the variety grown. (4) Barley is sown in the South usually as a pasture but sometimes to thresh. (5) In some sections a small acreage of wheat, oats, and rye is grown, while in others a single grain crop prevails.

Aims.—Beginners should learn how to select the best crop and the best variety for their particular sections and for their individual farms.

Problems for Study and Discussion.—(1) What effect will livestock on a farm have in the selection of a crop or variety?

2. What varieties are best adapted to your region?
3. Which would your rotation require, a fall- or spring-sown crop?
4. Which crops were grown most extensively in your state and community last year?
5. Will you grow the crop for hay or for grain?
6. Which of the small grains has the most valuable straw for feeding purposes?
7. For winter pasture which crop will grow best?
8. As a winter cover crop, which would you use?
9. Would this crop be best for green manure? Why?
10. Which crop is best adapted to the soil conditions of your region and home farm?
11. What effect will the market demands have on variety selection?
12. Which is best for soiling?

Activities.—Collect in bottles or glass jars seeds of as many varieties of these crops as possible. Label each and tell how extensively it is grown.

Varieties.—In determining the crop and variety it should be understood that wheat and rye are fall-sown crops in the South and that oats are sown either in the fall or in the spring, the time depending upon the variety and the purpose of the crop.

Some of the leading varieties of wheat adapted to the South are: (1) Fulcaster; (2) Red May; (3) Blue Stem; (4) Fultz. In the Southwest, (5) Turkey Red, a hard wheat, is grown quite extensively.

The varieties of oats chiefly grown are: (1) Winter Turf; (2) Burt; (3) Fulghum, and (4) Red rust-proof.

Varieties of barley are: (1) Tennessee bearded, and (2) Tennessee beardless.

There are very few varieties of rye grown in the South. Southern and Abruzzi are the two varieties principally grown in the warmer sections of the South.

The best guides for the selection of a variety are (1) your Experiment Station, and (2) successful farmers in the immediate neighborhood.

Uses of the Crops.—As previously stated, oats is grown chiefly for feeding livestock. It has no superior in feeding value for laying hens and growing chickens. The oat hay has a superior feeding value, and the

FIG. 72.—Wheat grown in the delta section of Mississippi, showing a good balance of plant food.

straw is preferred over that of wheat or rye. When sown in the fall, oats makes an excellent cover crop. It prevents soil washing and may be used for winter pasture.

Wheat makes an excellent winter cover crop. It is a good winter pasture and is hardier than oats. Beardless varieties are preferred by most farmers on account of being easier to handle at harvest time and, when cut for grain, furnishing a better quality of straw than the bearded variety.

Beardless barley makes good hay, particularly if grown with a legume.

Rye is usually sown for winter pasture, cover crop, and green manure. A good mixture for many places consists of one bushel of rye, one peck of crimson clover and eight pounds of vetch.

Influence of Livestock.—Small grains may contribute to the economic raising of livestock, and the livestock in turn may enable the farmer to return in the form of manure a large part of the fertility removed from

the soil by the grain (Fig. 72). The selection of crop and variety of small grain may be influenced largely by the number and kind of livestock, including poultry, on the farm.

Job 3. Deciding Acreage, Soil, and Field

Conditions Usually Found.—(1) Experienced farmers usually know how to choose a soil suitable for small grain. Some do not. (2) The best crop rotations are usually not well understood. This has a tendency to limit the amount of small grain sown in the South. (3) The fields are usually too small for most economic management. (4) Scarcity of labor at seeding and harvest times often reduces acreage.

Aims.—(1) Students should be able to adapt the crop to the soil. (2) Proper crop rotations should be studied and the grain crop placed in this rotation. (3) Factors governing economic selection of fields should be determined.

Problems for Study and Discussion.—(1) What are the soils best adapted to wheat, oats, barley, and rye?

2. Which of these crops require the best soil?
3. Formulate a crop rotation in which small grains will be used.
4. Of what importance is the preceding crop in selecting a field for small grain?
5. Which of these crops is considered best as a nurse crop for clover, for vetch, or for grass?
6. What difference do you find between soils where small grain is raised and those where a single crop is grown?
7. What are some of the factors that influence the size of the field for small grain?
8. Ask experienced farmers how much they depend on small-grain crops to supplement corn in years unfavorable for corn, and for feeding after corn is all gone in summer.
9. Make a survey to find out how many acres of each of these crops are grown by the farmers in the neighborhood.

Activities.—Tabulate data from a number of growers giving the kind of grain grown, average, soil and preceding crop in each case.

Soils for Small Grain.—Since wheat is usually a money crop, it should be sown on soil as rich as possible. A rich, heavy loam is best for wheat. A light, sandy soil usually results in a poor crop. Neither does wheat thrive on acid soils. Such soils may be made more suitable by the application of one ton or more of ground limestone per acre. Bottom land of the right soil type will produce large yields in favorable years, but the rank growth makes the crop more susceptible to rust and lodging than wheat grown on upland. Soil with considerable vegetable matter is best for wheat. Therefore a good crop to precede wheat is a legume. This preceding crop, of cowpeas or other legumes, should be so fertilized that it will produce a luxuriant growth which will add nitrogen to the soil. It is estimated that a crop of cowpeas preceding wheat will add from five to ten bushels per acre to the following wheat crop.

Oats and rye, while responding to rich soil, will produce a fair crop on land rather poor for wheat. These crops will grow on almost any soil where ordinary field crops succeed.

Rotations.—A good four-year rotation in the cotton belt, including wheat, would be as follows:

First year: cotton, with crimson clover and vetch sown between the rows in September.
Second year: cotton, with hairy vetch sown in September to be plowed under about the last of April.
Third year: corn with cowpeas.
Fourth year: wheat followed by cowpeas.

This rotation may be varied by growing lespedeza and red top in the wheat and omitting the cotton crop the next year. This would use cotton only one year in four.

Since land must be prepared early for cotton a winter legume preceding cotton does not have as much time to make growth as when it precedes corn.

A rotation with oats included would be similar to the one with wheat, where fall-sown oats prevails. Where spring sowing of oats is practised, the oats could follow either cotton or corn.

Some farmers prefer a winter cover crop each year, and practise a rotation as follows:

Cotton the first year, with crimson clover and vetch sown between the rows in the fall. On sandy soil vetch makes a better growth than crimson clover. This crop is plowed under in the spring and the ground planted to corn. The corn is followed with oats or wheat. Cowpeas or lespedeza and redtop are planted after the grain crop is removed, and one year is added to the rotation.

In some parts of the South suitable for corn, clover, small grains, and grasses, the small grains are used as a nurse crop for the legumes and grasses. As wheat is hardier than oats, it or rye is preferred as a nurse crop. Where small grain is included in the cropping system with proper rotations, humus is added to the soil, it retains its fertility, is more easily worked, and greater yields of all crops are secured. Therefore the acreage, field, and soil will be selected to fit in with the rotation prevailing on the farm, with the grain needs, the livestock demands, and the soil improvement program.

Points to Consider in Choosing a Field.—(1) Note the rotation used; (2) consider the richness of the soil; (3) the topography of the field; (4) the probable yield; (5) pests likely to be encountered; (6) experience of neighbors on similar land; (7) freedom from rocks, stumps, or other obstacles that might interfere with harvesting; (8) the accessibility of the field.

Job 4. Securing, Cleaning, and Testing Seed

Conditions Usually Found.—(1) Careful selection of seed is often neglected. (2) Few farmers treat seed before planting. (3) Small-grain seed is often mixed with foreign matter, such as weed seed, chaff, sticks, etc. (4) Few farmers test seed before sowing.

Aims.—(1) Beginners should learn the value of pure seed. (2) Study should be made and practice given in cleaning and recleaning seed before planting. (3) Methods of testing seed should be mastered.

Problems for Study and Discussion.—(1) Is it better to use locally grown seed, or to import it from a distance?

2. How do the farmers secure small grain seed for sowing?
3. Give methods of cleaning small grain.
4. List the reasons for cleaning and recleaning.
5. Give directions for testing seed.
6. Why should samples be tested before buying?
7. What are the advantages of testing seed?
8. What amount of seed should you secure?

Activities.—Operate a fanning mill and clean one bushel of seed. Calculate the number of quarts of each kind of material removed—weed seed, chaff, dirt, light seed. Test seed for planting.

Procuring Seed.—Experiments have demonstrated that home-grown seed should be used whenever possible. Varieties do not "run out"or degenerate by being grown continuously as do some other crops.

Some of the things to be considered in selecting seed wheat in the cotton belt are given: (1) It should be of the soft red types. (In the drier sections of the Southwest a hard wheat is sometimes preferred.) (2) It must be a high-yielding strain. (3) Earliness is desirable to reduce damage from rust. (4) The grains should be large and plump. (5) It should weigh around 60 pounds per bushel. (6) Beardless varieties are usually preferred on account of the greater ease in harvesting. Beardless varieties make better hay when the grain is sown for that purpose.

Of the oats varieties, Red Rust-Proof, Fulghum, and Appler are preferred in the southern tier of states. In the northern section of the South Winter Turf and Culberson are grown on account of being hardier.

As with wheat and oats, home-grown rye seed is to be preferred.

The amount of seed to be secured depends upon the method to be used in seeding, the time of sowing, the fertility of the soil, and the purpose of the crop.

The amount of wheat and rye sown varies from three to six pecks per acre. One and a half to two bushels of oats per acre is usually sown; one and a half bushels of barley.

Cleaning the Grain.—"Machine-run" grain, that is, grain just as it comes from the threshing machine, is not usually best for sowing. It should be run through a fanning mill and so well screened that the grains are of a uniform size, free from all such foreign matter as weed seeds, sticks, and chaff. The time and labor used in thorough cleaning of seed before

sowing is well repaid at seeding time. Where a fanning mill is not available the grain may be poured from a slight elevation during a brisk breeze and a large part of the foreign matter will be blown from the grain.

Testing Grain.—If the germination qualities of the grain are not assured, a test should be made to determine the percentage that will grow. This can be easily done by placing a given number of the kernels between sheets of blotting paper, dampened and set aside for a few days. After sprouting has taken place, a count can be made and the percentage of viable grain calculated.

Job 5. Providing Organic Matter

Conditions Usually Found.—(1) Organic matter is usually deficient in southern soils except in some choice localities. (2) Barnyard manure is sometimes available, but in many places it is limited.

Aims.—The importance of organic matter in soils should be studied and methods evolved for supplying it when deficient.

Problems for Study and Discussion.—(1) Make a survey and determine how many of the farmers in the locality make use of barnyard manure.

2. What methods are used in applying this manure with the least waste?
3. How many tons of manure are used per acre?
4. At what time of the year is it distributed?
5. Describe the practice of supplying organic matter by green manure crops.
6. What crops are grown for this purpose?
7. What special crops can be grown as cover crops and then turned under for green manure ?
8. What are the advantages of organic matter in the soil?
9. Compute the cost and the probable returns of applying barnyard manure to the land.
10. Likewise compute the cost of a green-manure crop and its value.

Activities.—Weigh out a pound of soil after it is air dry. In a fire shovel heat this enough to burn out the organic matter; re-weigh and calculate the percentage of loss of organic matter. In this way, compare two or more soils.

Barnyard manure is a valuable source of organic matter for soils and many farmers consider it, when available, the most economic method of enriching the soil. It has a stimulating effect when applied even in limited quantities. The amount to apply to soil depends upon a number of factors: (1) The crop to be grown; (2) amount of vegetable matter already in the soil, and (3) time of application. From two to six tons per acre are sometimes applied to wheat fields. Late winter or early spring is the usual time of application, and to the crop immediately preceding the grain crop.

Green Manure Crops.—There are a large number of crops grown in the South for soil improvement, among them being such legumes as crimson clover, vetch, sweet clover, bur clover, cowpeas, soybeans, velvet beans, and lespedeza. Wheat, oats, and rye, when used as winter cover crops along with winter legumes, are sometimes turned under in the spring before the planting of cotton or corn. (Fig. 73.)

Some of the things to be sought in turning under a soil improvement crop are (1) the greatest growth possible without injuring the crop that follows; (2) ample time for decay before sowing the follow-up crop. It has been estimated that a turned-under crop of crimson clover with a combined weight of roots and tops of two tons per acre is equivalent in its nitrogen supply and other effects to nearly eight tons of barnyard manure. A crop of cowpeas preceding wheat at the Arkansas Station, and turned under as a green-manure crop, resulted in an increase of thirty-nine per cent in the yield of wheat. Organic matter in soil improves the

FIG. 73.—Vocational student turning under green manure crop.

tilth, checks soil erosion, retains moisture, adds warmth to the soil, reduces loss through leaching, feeds helpful soil bacteria, and makes available the fertilizer elements.

Job 6. Buying and Mixing Fertilizer

Conditions Usually Found.—(1) Farmers usually buy ready-mixed fertilizers. (2) Low-grade mixed fertilizers usually result in a loss to the farmer. (3) In some instances farmers buy the ingredients and mix their own fertilizers.

Aims.—(1) Young growers should learn to interpret the formulas on fertilizer bags and tags. (2) They should be able to compute a formula where separate ingredients are to be used. (3) Calculations should be made for mixing the most economic fertilizers to meet varying soil conditions. The advantages of buying coöperatively should be studied.

Problems for Study and Discussion.—(1) How much plant food (nitrogen, phosphoric acid, and potash) is removed by an average local crop of (a) wheat? (b) oats? (c) cotton? (d) corn?

2. Why is it bad practice to farm continually without returning plant food to the soil?
3. What is meant by the formula 8–4–4 on a sack of commercial fertilizer?
4. How many of the farmers in your locality use commercial fertilizers for small grains?
5. How many buy the ingredients and mix at home?
6. Calculate at current prices the value of the plant food removed per acre from the soil as found in Problem 1.
7. What is the best time of the year to secure fertilizers for small grain?
8. Explain in detail how to mix fertilizers on the farm.
9. What is "filler"? What is its use? Can filler always be avoided?
10. Compare the cost of restoring the plant food as found in Problem 1 to a ten-acre oat field by first estimating the cost of a ready-mixed fertilizer, and then the cost of a home mixture.
11. What are the advantages of coöperative buying of fertilizers?
12. Why should the farmer buy his fertilizer at what is known as the "slack season" on the farm.

Activities.—Make a chart of the fertilizers offered for sale which you might use for your grain crop. Show prices and pounds per acre.

Practise mixing fertilizers until you can do the job with confidence. Calculate time required for mixing.

Plant Food Removed by Small-Grain Crops.—The amount of plant food removed by a crop is a guide to the kind and amount of fertilizer to be used in restoring this fertility. Experiment stations have found how much a crop of grain removes from soils. The results are shown in a table in the Appendix.

If the fertility of the soil is to be maintained, the farmer will need to replace somehow, some way, the plant food removed by a crop of small grain. This may be done by growing legumes, by applications of barnyard manure, or by the use of commercial fertilizers. Legumes add nitrogen from the air, but do not increase the content of phosphoric acid and potash. When cotton or corn is followed by a fall-sown crop of grain, the fertilizer applied to the summer-tilled crop may not be completely used up, and has a "carry-over" to the grain crop. This carry-over is called *residue.*

Costs of Nitrogen

(Three plans)

1. Winter legumes	2 tons	= 80 lbs. N.
Seed and labor		$2.50
Credit Winter pasture		$2.50
Cost per lb. of N.		0
2. Barnyard manure	8 tons	= 80 lbs. N.
Labor of spreading		$4.00
Cost per lb. of N.		5¢
3. Commercial fertilizer		
Nitrate of soda	533	= 80 lbs. N.
Cost per acre		$16.00
Cost per lb. of N.		20¢

Buying Fertilizers.—Prices of commercial fertilizers are usually higher at the time of the year when applied on account of the large demand

at that season, so many farmers plan to secure what fertilizers are needed at the off or "slack" season and thus get an advantage in price. This plan of securing the fertilizers at that time of the year when farm work is less pressing enables the farmer to calculate and mix the fertilizer ingredients to greater advantage.

Farmers growing winter grain therefore should purchase the fertilizer during the latter part of the summer when crop cultivation is over. For spring grain the purchasing and mixing should be done in the winter. Farmers often find it to their advantage to buy fertilizers coöperatively in car lots, whether they use home-mixed or the regular commercial product.

FIG. 74.—Barley on a delta farm near Ruleville, Miss., showing plenty of nitrogen in the soil from use of legumes.

Meaning of a Fertilizer Formula.—All states have laws requiring that mixed fertilizers sold on the open market shall be labeled or tagged showing the contents of each bag. A tag on a bag of fertilizer reading 7–3–4 (P–N–K) means that in each hundred pounds of the bag's contents there is found seven pounds of phosphoric acid, three pounds of nitrogen, and four pounds of potash. The remaining contents of the bag are partly filler, used to give bulk to the product. In a number of states the nitrogen is placed first in the formula instead of second (N–P–K).

Fertilizer Materials.—Nitrate of soda with a 15 per cent nitrogen content, or sulfate of ammonia, 20 per cent nitrogen, is usually used as the source of nitrogen. It is better to supply the nitrogen through the use of legumes in the rotation (Fig. 74). To supply phosphoric acid, the most common material is acid phosphate testing 16 per cent phosphoric acid.

Sulfate of potash testing 50 per cent potash; muriate of potash testing 48 per cent; or kainit testing 12 per cent are the sources of the necessary potash. (See fertilizer mixing table in cotton enterprise.)

Methods of Mixing.—A smooth floor should be selected for mixing fertilizers, having ample room for shoveling. Spread the ingredients on this floor in level layers, the largest in bulk at the bottom. Be sure that all large lumps are broken up. Then shovel the mass into another pile and back again, as in mixing concrete, until a uniform color is obtained.

Job 7. Liming the Soil

Conditions Usually Found.—(1) In many sections of the South the soil is deficient in lime. (2) Farmers are learning the value of lime in some sections and are using it to advantage. (3) Many farmers, however, fail to use lime even where it is easily obtained.

Aims.—(1) Growers should learn the value to be derived from liming, particularly where legumes are used in the rotation. (2) They should learn how to procure the best forms and the most economical uses.

Problems for Study and Discussion.—(1) What farmers have used lime in their crop rotations?

2. Make a survey to determine the source of lime for your locality.
3. Determine the cost per ton of the lime.
4. Learn to test soil for acidity.
5. How much lime would you apply per acre?
6. Study methods of applying the lime.
7. What are the different forms of lime to be had in your region?
8. What are the benefits to the soil of liming?
9. What crops need liming most?
10. How would you make the application of lime if clover is seeded in the small grain?

Activities.—Practise testing soil for need of lime, using any good available method. Collect samples of lime, obtaining prices and composition of each.

Need of Lime for Grain Crops.—The great majority of the soils of the South are deficient in lime, and an application of lime in proper amounts will result in increased yields. Lime (1) stimulates the decomposition of organic matter; (2) neutralizes acids in the soil; (3) improves the physical condition of heavy soils; (4) supplies a needed element to growing plants; and (5) makes available other elements in the soil. Lime is particularly beneficial where green-manure crops are turned under.

Of the small grains wheat needs a larger content of lime in the soil than oats or rye. Where clovers are raised in connection with small grains, lime is beneficial and on certain soils it is necessary to successful growth. When clover is sown in small grain the lime is applied immediately preceding the sowing of the clover.

When Soils Need Lime.—The need of lime on a field is shown when clover or alfalfa will not grow. Other indications are the presence of certain weeds, such as sheep-sorrel or moss. Soils where drainage conditions are bad are usually acid and are benefited by drainage and by liming. Sassafras trees or scrubby oak or jack pine indicate acid soil. A laboratory test for soil acidity may be made.

Forms of Lime.—Ordinary ground limestone, burned lime, and marl are the most common sources of agricultural lime, although chalk, coral, and oyster and clam shells are other sources less widely distributed.

Ground limestone is perhaps the most common form used by farmers. This is prepared by a grinder, and the product varies from a fine powder to a coarse granular state. Burned lime is extensively used for agricultural purposes also. It is prepared by burning limestone in kilns under conditions of great heat without much moisture or air. It is this form of lime which is used in making mortar for masonry or plaster. (See U. S. Farmers' Bulletin 921.)

Rate of Application.—Heavy applications of pulverized or ground limestone may be used every four or five years at the rate of several tons per acre. Burned lime or "quicklime" is applied at the rate of 1000 pounds or more to the acre at intervals of one or two years. Smaller applications may be used to advantage. The rate of liming depends upon the kind of lime, condition of the soil, the crop grown, climatic conditions, and time of application.

Method of Liming.—Lime is usually applied to the surface of the soil after plowing. It should never be plowed under. One harrowing after liming is advisable before seed are sown. Lime is spread with a fertilizer drill, or it may be shoveled from the rear end of a wagon. Some distribute it with a manure spreader.

Job 8. Preparing the Seed Bed

Conditions Usually Found.—(1) Through years of experience farmers usually prepare the seed bed well. (2) Some use shiftless methods. (3) Some use methods more expensive than necessary. (4) A few follow the bad practice of sowing immediately after plowing.

Aims.—(1) Students should learn the economical methods for their communities. (2) The reasons for a well-settled seed bed should be studied. (3) Relative values of fall and spring plowing should be determined.

Problems for Study and Discussion.—(1) Why should the soil be plowed several weeks before the grain is sown in the fall?

2. How many of the farmers in your locality allow the soil to settle before sowing?
3. Why do some farmers sow immediately after plowing? How could this be avoided?
4. How deep do the farmers of the community plow for small grain?
5. When is double disking preferable to plowing?
6. Compare the cost of double disking with cost of plowing.
7. What farmers have had difficulty in getting a good stand of grain after sowing?
8. How can soil be settled if there is only a short time between plowing and sowing?

Preparing the Seed Bed.—The small grains require a fine mellow seed bed of a depth of three or four inches with a firm subsoil for best results. Where the ground is plowed it is best to turn it at least a month before sowing. The plow should be followed with a spike-tooth harrow

and the ground pulverized and smoothed. If a cultivated crop, such as corn, tobacco, or cowpeas, precedes the fall-sown grain, disking is usually practised. This is often as satisfactory as plowing and requires less labor. As soon as the crop is removed the ground should be gone over with a disk to prevent the growth of grass and weeds. A second disking, followed by a harrow, is given just before the grain is sown. When small grain follows cotton the stalks are plowed under as soon as the bolls are all open and the cotton picked. Under such conditions, plowing should be deep enough to bury the stalks completely. The land should then be firmed with a rough roller or cultipacker. The grain is then sown with a disk drill. When cotton stalks are turned under, harrowing is not advisable, as it may unearth cotton stalks.

Small grain is sometimes sown in the standing cotton stalks with a small one-horse drill when the land is free from weeds and grass.

When it is necessary to plow just before seeding the soil should be compacted by rolling and harrowing several times before seeding.

Where spring grain is sown in the cotton belt the time of plowing depends largely upon weather conditions. Excessive rainfall in the winter months in many sections makes it imperative that the plowing be done at any time in the winter when the soil conditions permit.

Job 9. Treating Grain for Smut

Conditions Usually Found.—(1) Much of the small-grain crop is sometimes lost through failure to treat the grain before seeding. (2) Growers in some sections treat grain for smut before sowing.

Aims.—Beginners should make a study of the objects and methods of treating grain before seeding.

Problems for Study and Discussion.—(1) Make a study of the losses from smut diseases and report to class.

2. Describe methods used in treating grain for smut.
3. Explain the two kinds of smut that attack the wheat crop.
4. Explain a method of treating for (a) loose smut; (b) stinking smut.
5. Estimate the value of treating grain for smut.
6. Study samples until you can identify smut.
7. Calculate the cost of treating the grain for an average-sized field.

Activities.—Practise treating seed to prevent smut. Make a comparison in growth between treated and untreated seed.

Reasons for Treatment.—Certain diseases attack all of the small grains and result in a reduction of yields. The most common of these diseases are rusts and smuts. By learning the nature of these diseases and the effective remedies, the farmer may be able to prevent much of the loss of grain that might otherwise occur. These plant diseases are caused by minute forms of vegetable life, chiefly fungi, or disease-producing germs. Fortunately the spores of most fungi are killed more easily by heat or by certain chemicals than the seeds of the grain crops on which

they feed, so that they may be eradicated by proper treatment of the grain before seeding.

Grain Smuts.—The wheat crop may be affected by two kinds of smut. One is known as loose smut, and the other as stinking or hidden smut. These two kinds of smut may be identified by the manner of the attack on the wheat. Loose smut affects the entire head of the wheat, forming a black mass, while stinking smut affects the kernels only. In the latter case the kernel, instead of developing normally, is filled with a dark dust-like mass which has a peculiar offensive odor.

Treatments for Smut.—The formalin treatment usually used for the control of smuts in grains is ineffective for loose smut. Hot water is usually used for this disease. The treatment is rather difficult, requires

FIG. 75.—Student farmers treating seed grain for smut.

considerable time, and if care is not taken reduces materially the germination of the seed. This treatment is usually resorted to only to get a small quantity of grain for a seed plot. The procedure is as follows. The grain to be treated is soaked for about four hours in water at ordinary room temperature, to make the organisms more sensitive. Then the grain is allowed to drain for a short time, after which it is placed in containers of about one gallon capacity and plunged into water at a temperature of 120 degrees F. and left for one minute. It is then transferred to another tub of water with a temperature of 131 degrees and agitated for ten minutes. The grain is then spread out to dry, after which it is ready for sowing.

For stinking smut, the formalin treatment is usually used, although the hot-water method is also effective. After the grain has been thoroughly cleaned by a fanning mill, it is spread in a thin layer on a clean floor. It

is then sprinkled with formalin (1 pint of formalin to 40 gallons of water) (Fig. 75). One gallon of the mixture is usually sufficient for one bushel of wheat. After the grain has been treated it is covered with blankets or canvas for from five to twelve hours, after which it is spread out to dry. Grain in loose sacks may be immersed in the above liquid for ten minutes and then spread out to dry.

The loose smut of oats may be prevented by treating the seed oats with the same formalin method used for stinking smut of wheat.

Job 10. Sowing Seed and Applying Fertilizers

Conditions Usually Found.—(1) Sowing the grain and distributing fertilizer are usually done at the same time. (2) Methods of seeding vary in the South to meet local conditions. (3) Better methods are desirable in many localities.

Aims.—(1) Young farmers should study the different methods of seeding, and adapt the best methods to their own conditions. (2) They should understand rates of seeding and proper depths of covering. (3) Economical methods of applying fertilizer should be mastered.

Problems for Study and Discussion.—(1) Make a survey of the community and list all the different kinds of seeders.

2. Describe a fertilizer attachment.
3. Compare the amounts of seed needed in hand sowing and in drilling.
4. Find the usual rate of seeding and method of covering in your locality for (1) oats; (2) wheat; (3) rye.
5. Find the kind and amount of fertilizer used for each grain.
6. Compare the costs of drilling and hand sowing.
7. Secure samples of seed grain and compare.
8. What treatment, if any, is given the field after sowing?
9. What is the advantage of the fertilizer attachment?
10. Why do some of the grain drills have grass or clover seed boxes?
11. What is the best time for sowing small grain in your locality?

Activities.—Operate grain drills and other seeders. Compare the costs of seeding by different methods. Compare results in growth and yields.

Hand Seeders.—Small grain is sometimes sown broadcast by a small hand seeder or from a large seeder attached to the back part of a wagon body. These methods are not so popular as drilling because (1) much of the grain is wasted; (2) more seed per acre must be used; (3) even stands are less likely to result; (4) an extra harrowing after seeding is necessary; (5) birds consume more of the seed; (6) the grain is likely to be covered too deep or too shallow.

Grain drills may be divided into three classes according to make. They are (1) shoe, (2) hoe (Fig. 76), and (3) disk drills. The disk drill (Fig. 77) is preferred where litter, such as corn stubble, is present. Rings, chains, or press wheels are the covering devices used with the seeders. The drills and covering attachments should be suited to the soil, the climate, and the season. The press wheels compact the soil and thus aid in bringing capillary moisture to start germination. The chain drags tend to form a mulch which retains the moisture. In using a drill attention

must be given to the seed box and feeding tubes to see that a supply of grain goes to each tube constantly.

A fertilizer bin on a grain drill saves much work by distributing the fertilizer at the same time the grain is sown. Furthermore, when a com-

FIG. 76.—A wide hoe drill seeding with tractor power.

panion crop is grown with the grain, a seeder attachment permits seeding this crop with the grain and thus saves time and work.

FIG. 77.—This student is drilling in the seed for his small-grain project, with a disk drill

Rates of Seeding.—Grain drills have gages or regulators for sowing different amounts of grain. The gage is set for a certain amount and the operator then needs only to see that all openings are adequately supplied. Small grain is sown at varying amounts, from three to eight pecks per

acre, depending upon the kind of grain, richness of soil, and time of year when planted (Fig. 78). Fall-sown grain requires less per acre than spring-sown grain; and early fall-sown grain requires less than late fall-sown grain. Some varieties of grain "tiller" or "stool" more than others, and thus require less seed. More seed may be used on rich soil than on poor soil (Fig. 79).

Time of Seeding.—In the southern part of the United States rye, wheat and barley are sown in the fall, while oats may be sown in either

FIG. 78.—Heavy yield of rye due to using plenty of seed. (J. M. Weeks.)
FIG. 79.—Oats yielding 60 bushels an acre. Grown at the Sunflower Agricultural High School, Moorhead, Miss. No fertilizer used. (J. M. Weeks.)

fall or spring, according to the variety grown, the latitude, and the method of seeding. Where Hessian flies are likely to be present, wheat should not be sown until October 10 or later, after the flies have laid eggs elsewhere.

Depth of Seeding.—Broadcasting or hand seeding is likely to result in uneven depth of covering, some seed being covered too deep and other seed too shallow. Where a drill is used the depth can be regulated to suit the type of soil, amount of moisture at seeding time, and the season of the year. The depth usually varies from one to two inches for wheat and rye. Oats are usually drilled deeper, since they require more moisture. In

heavy or damp soils less depth is required than in light or dry soils. Quick germination is always desirable.

In some dry, windy regions the open-furrow method is used for fall sowing of oats. By this method the seed are sown in drills or furrows several inches deep and from 16 to 24 inches apart. The ordinary single-row planter or a specially devised drill is used. The roots and crowns of the plants are 2 to 3 inches below the surface so the light, dry soil is not so easily blown from the plants. Oats grown by this method withstand the winter better than surface-sown oats.

Fertilizing Small Grain.—Where the soil is deficient in plant food and commercial fertilizers are used, acid phosphate is the chief material used in the fertilizer box at seeding time. This is applied at the rate of 100 to 200 pounds per acre for oats, and sometimes double this amount for wheat. The most universal need of oats on the average southern soil is nitrogen. Since oats make their growth in the cool part of the year, when vegetable matter does not nitrify rapidly or become available as plant food, the best form of nitrogenous fertilizer is one which becomes immediately available. Nitrate of soda, therefore, ranging in amount from 40 to 160 pounds per acre and sown broadcast as a top dressing, about two months before harvest, is used by many. This treatment of the field after sowing is necessary because of the solubility of the nitrate. It needs to be applied when the root system of the plant is partly developed and the season advanced to the point where plant food is readily absorbed.

When nitrate of soda is applied to wheat fields the same rule holds as for oats. That is, the application is made two months before the date of the anticipated harvest. This usually means that in the Gulf states the nitrate of soda is applied by or before the twentieth of March, and in the higher latitudes at correspondingly later dates. Eighty pounds per acre is the amount usually used, although good results have been obtained from amounts ranging from 40 to 120 pounds per acre.

Job 11. Sowing Legumes with Small Grains

Conditions Usually Found.—(1) Many southern farmers grow a companion crop with the small grain. (2) Some who should, do not do so.

Aims.—(1) Students should learn the methods of growing companion crops. (2) The cost should be compared to the benefits.

Problems for Study and Discussion.—(1) What legumes are grown in your locality as companion crops?

2. What crops can be profitably grown?
3. What methods are used in seeding these companion crops?
4. What combination is best (a) for soil improvement? (b) for hay?
5. Explain method of seeding when vetch, clover, or lespedeza is sown with grain.
6. Which grain crop is best to combine with vetch when seed are desired?

Activities.—Practise sowing legumes and covering the seeds properly when they are to grow with small grains. Compare two different methods.

Hairy Vetch.—While practically all of the many varieties of vetch may be grown in the South, the one commonly known as hairy vetch is best adapted to the soils and climate of the cotton belt. It is more resistant to cold than any other annual winter legume. It is less likely to require lime than bur clover, crimson clover, or sweet clover. It is adapted to a wider range of soils than the other winter legumes and succeeds on nearly all soil types of the South. Like other leguminous plants it will, when inoculated, enrich the soil with nitrogen and organic matter. The best time for seeding hairy vetch in the South is from August 15 to October 15. This coincides with the time of sowing wheat, rye, or oats, and

FIG. 80.—Rye and vetch on the Nesheba School Farm, Miss.

therefore the two operations may be combined in one. When hairy vetch is planted for the first time the soil or the seed should be inoculated. This may be done by the agglutination method described in the clover enterprise.

Rye is the preferred crop with vetch when used for soil building (Fig. 80), and oats when it is grown for hay or for seed (Fig. 81). The seed of hairy vetch is difficult to separate from wheat, so it is seldom grown in combination with this crop.

Other Companion Crops.—Red and crimson clover, lespedeza, and bur clover are other crops grown at times in combination with small grain. The clovers are usually fall-sown. Lespedeza seed is sown broadcast

in the spring on winter grain or may be sown broadcast on spring oats after the seeding of the oats is done, care being taken not to harrow-in the seed on a loose soil. The winter grain field is usually harrowed with a slant-tooth harrow crosswise of the grain rows before lespedeza is sown,

FIG. 81.—Vetch and oats grown together on the Laboratory Plot at White Oak Consolidated School. (J. C. Taylor.)

to give the seed a lodging place. Otherwise excessive spring rains may wash the seed to the low places or remove it entirely from the field.

Job 12. Controlling Grain Enemies

Conditions Usually Found.—(1) The Hessian fly is injurious to wheat and other small grains. (2) Rust, scab, and smut are particularly harmful in certain sections of the South. (3) Weeds are encountered in all districts.

Aims.—(1) Growers of small grains should understand the injury done by insects and diseases and should learn how to control them. (2) The best methods for controlling weeds injurious to grain crops should be studied. (3) The best farm practices should be mastered.

Problems for Study and Discussion.—(1) To what extent is the Hessian fly or chinch bug injurious to crops in your region?

2. What are the methods of preventing grain smuts?
3. What is the cause of grain rust?
4. What weeds are most injurious in your locality?
5. How can these be best controlled?
6. What insects are injurious to stored grain?
7. What is the treatment to prevent this?
8. How can we prevent heating in bins, elevators, and cars?
9. Determine the injury to stored grain by mice and rats, and give remedies.
10. Give remedies for (a) weevil; (b) chinch bug; (c) smut; (d) Hessian fly, and (e) rust.

Activities.—Make a large collection of grain insects and diseases and their work. Label each and give remedy.

Insect Enemies.—Hessian flies are particularly injurious to wheat (Fig. 82). They do less damage to oats and rye. Tiny maggots hatch from eggs laid by the flies on the leaf blades of the young plants. These insects find their way to a joint within the leaf-sheath where they cause the stems to break and fall over in the spring before harvest time. The best method of preventing damage from Hessian flies is crop rotation and late planting. If the crop is planted late the females have laid their eggs on grasses and other plants, and have disappeared. Rotation of crops helps because the insects cannot travel far unless conditions are favorable. Plowing under the stubble immediately after harvest destroys the flies to some extent.

FIG. 82.—Class of vocational agriculture boys making a field study of the effect of Hessian fly on wheat.

Chinch Bugs live over winter in rubbish, border grass, and weeds. They usually attack the crop in the spring. These insects suck the sap from the stem of the plant, beginning near the ground and working upward. Eradication consists in burning all weeds and rubbish in the hedgerows, fence rows, borders of fields, and along roads. In summer, after the grain is cut, the chinch bugs migrate to nearby corn fields. Prevention is described in the corn enterprise.

Disease Enemies.—*Smuts* are of fungous origin. Much loss is sustained from these diseases. The smut plants start when the grain germinates, and grow within the plant until heads are formed. The masses of spores may be seen in the head where the kernels of grain should be. Treatment for smut is given in Job 9.

Grain Rust is a disease affecting the leaves, stems, and heads of small grain crops. Yields are greatly reduced when the attacks of rust come early (Fig. 83). The rusts are not preventable by seed treatment. A

common form of rust is known as orange leaf rust. This can be identified by the reddish spots on the leaves and stems. A kind less common, but even more destructive, is the black stem rust. This disease spends one stage of its life on common barberry shrubs. By destroying these bushes

FIG. 83.—This vocational student and his teacher are examining wheat to see if it is damaged by rust.

FIG. 84.—Student cutting his Red-Rust-Proof oats which yielded 60 bu. per acre without fertilizer. (J. M. Weeks.)

the effects of rust may be reduced. Varieties of grain ripening early usually escape rust, and some are in a measure rust-resistant (Fig. 84).

Ergot is a disease affecting rye. It causes the affected grains to enlarge and project from the head. Such grains are poisonous to livestock. Preventive measures consist in planting disease-free seed and sowing on fields that have not been contaminated.

Storage Enemies.—Grain moths and weevils are often injurious to stored grain. This injury can be prevented by treating the grain with carbon bisulfide. For this treatment the bins should be nearly air-tight. One pint of the liquid for every five hundred cubic feet should be provided. This liquid is placed in containers at convenient intervals on the surface of the grain. An air-tight covering is then provided. The fumes from this liquid, being heavier than air, permeate all parts of the bin and destroy the weevils. If the weather is warm a second treatment should be given after two weeks.

Much damage to stored grain is inflicted by mice and rats. This loss can be prevented by building mouse-proof bins, by trapping, and by poisoning.

Grain sometimes heats in the bins if stored when not thoroughly dry. This can be prevented by ventilation, or by shoveling about from one part of the bin to another, or by transferring to another bin. This is often necessary in the early part of the storage season.

Weed Enemies.—Since small grain cannot be cultivated after it is sown, weed control must be a matter of thorough preparation of the soil before sowing. The time and method of sowing should be such that the grain crop will get a start ahead of the weeds and prevent their growth. The same weeds are troublesome in oats and wheat. Cheat or chess and wild onion are the chief weeds of the fall-sown grain crop. Clean seed that has been carefully fanned and screened should be used to avoid these enemies. Care should be taken also that the seed grain, particularly oats, should not contain any Johnson grass seed.

Job 13. Harvesting the Crop

Conditions Usually Found.—(1) Farmers generally use methods best suited to their conditions. (2) A wide variation in conditions and methods is found in the South. (3) Improved methods would be advantageous in some localities.

Aims.—(1) Students should be able to determine the best method of harvesting for the locality in which they live.

Problems for Study and Discussion.—(1) How many different ways do farmers in your locality harvest small grain?

2. How many self-binders are there?
3. When are a mower and hay rake used?
4. Why shock grain in the field instead of stacking immediately after cutting?
5. Give reasons for and against stacking the grain before threshing.
6. How many shockers are needed to one binder?
7. How many farmers own a reaper in common? A mower?
8. What is a header? Are any used in your locality?
9. What are combine harvester-and-thresher machines? Are any used in your locality?
10. Describe a good method of shocking.
11. How many men are needed to operate a thresher, (a) when grain is stacked? (b) when it is threshed from the field?
12. What is soiling? When and how is small grain harvested in this way?

Activities.—Practise the different harvesting operations. Assist in harvesting the crops, timing yourself in the different operations.

Harvesting Oats.—A large part of the oat crop of the South is fed to livestock, either as loose hay or in the sheaf. The time of harvest

Fig. 85.—Harvesting grain with self-binders in the South.

and the method used will depend largely upon the use made of the crop. An oat crop to be harvested for hay is cut with a common mower, in the milk stage, and handled the same as other hay. If used as a soiling crop,

Fig. 86.—The binder pulled by a tractor saves much horse labor.

the oats are sometimes cut with the old-fashioned cradle. The mower is best where the fields are level. Cutting begins for soiling as soon as the heads form and continues until the grain is nearly ripe.

The self-binder is usually used for ripe grain. This machine cuts the grain and binds it into sheaves or bundles in one operation (Figs. 85 and 86). When a binder is used the grain is allowed to stand until it reaches

FIG. 87.—Teacher giving instruction to agricultural student on the job of shocking grain.

the dough stage. After being cut with the binder the bundles are set up in shocks of about a dozen each, and allowed to cure (Fig. 87). After curing, the crop is stored for feeding in the sheaf, or the grain is threshed and stored in bins.

FIG. 88.—Arkansas boy harvesting his wheat project.

In the South it is customary to sow vetch with the oats and cut for hay. This combination makes a most excellent feed and at the same time helps to enrich the soil.

Harvesting Wheat.—The usual method of harvesting wheat is with the binder (Figs. 88 and 89). While this machine is expensive, it lasts a number of years if care is taken in its operation and in housing it when not in use. In some localities the binder is owned by a number of farmers and used coöperatively. This has the advantage of requiring a smaller investment from each individual farmer, and is more economical when the acreage is small.

In some sections of the Southwest headers are used for harvesting wheat. These machines clip the heads only, leaving a large part of the straw in the field. The heads, when cut, are elevated to a wagon called a header barge, hauled to the stack yard, and placed in stacks to await the thresher.

Fig. 89.—Grain binder with long cutter bar. This width of cut is suited to tractor work.

Combine harvester-and-thresher machines (Fig. 90) are found in some dry sections where wheat is the principal crop, or where farmers coöperate in community-owned harvesters. This machine cuts and threshes the wheat at the same operation. It has advantages over older methods, some of which are given:

(1) Prevents loss of grain from too much handling.
(2) Reduces cost of threshing.
(3) Requires no twine.
(4) Reduces labor costs.
(5) Requires less horses, wagons, and other equipment.
(6) Operates with less men.
(7) Makes less work for women.
(8) Allows earlier fall plowing.
(9) Permits early sowing of cowpeas as a follow-up crop.
(10) Returns straw at once to the field as fertilizer.
(11) Reduces injury to grain by weather.

Harvesting Rye.—When grown for grain, this crop is harvested similarly to wheat. It is sometimes grown with vetch and cut as hay, but is not so good in quality as oats. Rye makes a good soiling crop when cut early in the spring before the straw stiffens or becomes too hard for feed. A cradle, scythe, or mower is used to cut the rye when fed direct from the field.

FIG. 90.—Vocational agriculture boys overhauling a combine in preparation for harvest in the heart of the wheat belt.

Shocking Grain.—When grain is cut with the binder it is usually shocked. The bundles are set on end with the grain up in such a manner as to brace each other. About a dozen bundles are placed in a shock, sometimes more or less according to size. One or two sheaves are spread over the top of the shock to shed the rain and the crop is left in this manner to cure or go through the "sweat" before threshing.

Stacking Grain.—In some sections wheat is stacked after it has been cured in the shock. Small stacks are made and so arranged that they are convenient for threshing. Stacking before threshing time saves a

number of teams as compared to where the grain is hauled direct to the thresher from the field. The straw is better preserved and grain may be held until late in the fall, when prices may be better than at harvest time. The practice has the disadvantage of requiring more total labor.

Job 14. Threshing Grain

Conditions Usually Found.—(1) Most small grain is threshed within a few weeks after harvest. (2) Threshing is done early after harvest from the shock and later in the fall from the stack. (3) In some sections of the South threshing-machine service is hard to obtain.

Aims.—(1) Students and farmers should learn the best methods of threshing. (2) They should learn the importance of proper care of the straw. (3) Market demands of grain should be mastered.

Problems for Study and Discussion.—(1) Find the common practice for threshing grain in the community.

2. What are the advantages of threshing from the shock? From the stack?
3. Who own the threshing machines in your locality?
4. To what extent do farmers exchange work in threshing?
5. How is the straw cared for after threshing?
6. What is the value of the straw?
7. Which of the small grain straws are more valuable (a) for feeding? (b) for packing? (c) for bedding?
8. What are the rates paid for threshing?
9. Examine a thresher and be able to describe how it works.
10. Describe a combine harvester-and-thresher machine.

Activities.—Participate in threshing operations, time the different men and teams. See if you can make a better assignment of their work to avoid wasting time waiting for the machine.

Threshing Grain.—The job of threshing is one of the most particular in the small-grain enterprise. Threshing time is the busiest season of the year on the farm. The threshing machine requires a larger number of men to operate it than other farm machinery. Neighbors are usually employed to help at this season. It is a common practice for one neighbor to exchange labor with another during the threshing season. In this manner some cash outlay may be saved. However, in some sections the threshing machine is run with a regular crew and the farmer simply has the responsibility of hauling the grain from the machine. Where the grain is threshed from the field or from shocks a number of additional teams, wagons, and men are required over threshing from the stack. The combine plan for a community, of some threshing from the shock and others threshing from stacks, prolongs the threshing season and enables the community to get along with fewer machines (Fig. 91).

Where a combine harvester-and-thresher is used, the grain is left standing until it is thoroughly ripe. By this method the grain can be hauled direct from the field to market or to storage (Fig. 92).

Care of the Straw.—The straw of small grain is valuable and should be saved. After the grain has been removed by the separator the straw

is stacked in such a way as to shed rain or is baled and stored. Oat straw is considered best for feed, while wheat and rye straw are preferred for bedding and for packing.

FIG. 91.—This small threshing unit is easily handled by a few men. A group of neighbors may own one together and help each other at threshing time.

FIG. 92.—Combined harvester-thresher machine, which has many advantages over the old methods of using separate machines for each step of the process.

Job 15. Storing the Grain

Conditions Usually Found.—(1) Some grain in the South is sold direct from the thresher. (2) Much of it is stored. (3) Some farmers have bins in barns. Others have granaries.

Aims.—(1) Growers should learn the reasons for storing and best methods of storing grain. (2) They should learn how to avoid losses during storage.

Problems for Study and Discussion.—(1) How many of the farmers in the community have permanent grain bins?
2. Compute the number of bushels in some bins.
3. Where should a granary be located in reference to other buildings?
4. What effect does the location have on insurance rates?
5. Find the cost of wooden bins as compared to metal bins.
6. Why store grain?
7. What are some of the losses incurred by storing grain?
8. How may stacking save other storage?

Activities.—Draw plans for a separate granary building. Make list of materials, estimate the cost.

The location of storage bins for small grain depends somewhat on the use of the grain. Oats for feed should be stored in or near the barn to save time in feeding. The bin should be accessible also from the threshing yard. Where the grain is stored for a time before marketing the bin should be removed from other buildings to reduce the fire hazard. This enables the farmer to secure insurance at a lower rate. Bins should be mouse-proof, and if the grain is to be stored for some time they should be so built as to permit treating the grain for weevils.

Advantages of Storage.—Some of the advantages of storage are given: (1) It enables farmers to market the crop in an orderly manner, and tends to prevent dumping. When all the grain is thrown on the market at harvest time the market is flooded and prices suffer in consequence. (2) At threshing time all the available teams and men are usually needed to keep the thresher busy. (3) The grower has little time to attend to the important details of marketing. (4) Prices are usually better during the winter months and the farmer has more time for hauling and marketing.

Job 16. Using the Straw

Conditions Usually Found.—(1) Farmers in the South have use for the straw in most cases. (2) Some straw is burned or otherwise wasted. (3) Straw is used for feeding livestock, for bedding, and for packing.

Aims.—(1) Managers should learn the uses to be made of straw, and how best to preserve, use, and market it.

Problems for Study and Discussion.—(1) Which of the kinds of straw is best for feeding?
2. What is the relation of good threshing to feeding value?
3. Describe method of handling straw when used for feeding.
4. What livestock may be fed straw?
5. Why is baled rye straw higher in price than other straw?
6. Name the commercial uses of straw.
7. Compare straw with other materials for bedding livestock and for litter in poultry houses.
8. What is the cost per ton for baling straw?
9. When does it pay to bale straw?

Uses of Straw.—Oat straw is a valuable feed for work animals or for wintering livestock. Wheat and rye straw are not generally used for feed. Straw from bearded barley is objectionable for feeding horses and

mules. All grain straws make good bedding. Wheat and oat straw are used for litter in poultry houses. Rye straw, when the grain is threshed in a certain way, is used for packing nursery stock and for making horse collars.

Baling Straw.—When the straw is to be shipped to localities where loose straw is not available it is baled. The cost of baling varies with the capacity of the baler and the quantity of straw available. From one

FIG. 93.—This baby-beef project was wintered on oat hay as the roughage in the ration.
FIG. 94.—These cattle were wintered on oat hay and unthreshed sheaves, and good rye pasture.

and a half to two dollars per ton is the prevailing price in many localities.

The feeding value of straw is dependent somewhat upon the efficiency of threshing machines. When a thresher leaves much grain in the straw the feeding value is correspondingly improved. Present-day threshers, however, leave little grain in the straw and the feeding value is dependent upon the value of the straw itself. Stacking grain until winter aids in saving the feeding value of straw.

Rotted straw from an old strawstack, or from straw spread directly on the field, makes good manure, as each thousand pounds of straw con-

tains on an average about 5 pounds of nitrogen, 8 pounds of potassium, and smaller amounts of other plant foods.

Oat hay with grain well formed is often used to feed livestock to supply both grain and roughage (Figs. 93 and 94).

Job 17. Marketing and Using Grain

Conditions Usually Found.—(1) Most grain grown in the South is used on the farm. (2) Limited quantities are sold to nearby mills or shipped to central markets (3) Some grain is marketed through coöperative associations.

Aims.—Producers should understand the uses and the marketing grades. They should be able to judge grain according to market standards.

Problems for Study and Discussion.—(1) What are the market grades?
2. Why do some receive a higher grade for grain than others?
3. What materials are removed from grain by the thresher and what by the fanning mill?
4. What is the work of a coöperative association in respect to marketing grain?
5. How many farmers in your state belong to a coöperative marketing association? What do others think of associations?
6. What are the advantages of the coöperative association?
7. To what extent do farmers coöperate in loading cars and in transportation?
8. How much of the local crops of grain are shipped from your community? How much used locally?
9. Which of the small grains are best for grinding or crushing for livestock?
10. How would cleaning grain before selling improve grade and price?

Activities.—Practise grading small grains. Clean grains for seed or for market.

Market Grades for Wheat and Oats.—There are five market grades of wheat, ranging in weight from 60 pounds to the bushel for Number 1, to as low as 49 pounds per bushel for Number 5. The moisture content for Number 1 is 13.5 to 14 per cent; for Number 5, 15.5 or 16 per cent. Other factors influencing grade are foreign material and damaged kernels.

Oats of each type is given four grades. Number 1 should be cool, sweet, and of good color. Number 2 is the same as Number 1, except it may be slightly stained. Weight is an important factor in grading oats.

Home Marketing.—The oat crop of the South is marketed at home by feeding to livestock. The value of this crop for feeding horses and mules is well understood. The market prices of oats in the South are usually so high that this grain can seldom be fed with profit to other classes of animals. Oats is particularly valuable for feeding to colts and to other young and growing livestock. It also makes a valuable part of the poultry ration. Important values of this grain for feeding young animals and poultry are due to its high proportion of ash and protein. A very common practice in the South is to feed oats in bundles to work stock. The Red-Rust-Proof and other southern varieties differ from northern spring oats in that the leaves and stems are still quite green when the grain is nearly ripe. Hence the straw is much better feed. Feeding oats in the bundles

GRADE REQUIREMENTS FOR WHITE, RED, GRAY, BLACK AND MIXED OATS

GRADE	CONDITIONS AND GENERAL APPEARANCE [1]	MINIMUM TEST WEIGHT PER BUSHEL	SOUND CULTIVATED OATS NOT LESS THAN—	HEAT-DAMAGED (OATS OR OTHER GRAIN)	FOREIGN MATERIAL	WILD OATS	OTHER COLORS, CULTIVATED AND WILD OATS
				Not to exceed—			
		Pounds	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1[2]	Shall be cool and sweet and of good color.....	32	98	0.1	2	2	2[3]
2	Shall be cool and sweet, and may be slightly stained.....	29	95	.3	2	3	5[4]
3	Shall be cool and sweet, and may be stained or slightly weathered....	26	90	1	3	5	10
4	Shall be cool, and may be musty, weathered, or badly stained.....	23	80	6	5	10	10

[1] The percentage of moisture in grades Nos. 1, 2, and 3 shall not exceed 14½, and in grade No. 4 shall not exceed 16.

[2] In the case of white oats, No. 1 shall be cool and sweet and of good white or cream color.

[3] Four per cent of other colors allowed in No. 1 red, gray, or black oats. This column does not apply to mixed oats.

[4] Ten per cent of other colors allowed in No. 2 red, gray, or black oats.

A *sample* grade is established below 4 in each type of oats usually sold by sample.

provides both grain and hay for the animals and saves the expense of threshing and of providing bins for storage.

Rye is abundantly used in the South as a winter cover crop and for winter pasture, mixed with legumes. Wheat, also, is sometimes used as a cover crop. (Figs. 95 and 96.)

Cleaning Grain.—A good threshing machine has a grain-cleaning equipment which ordinarily cleans the grain ready for market. Sometimes, to conform to the highest market requirements, the grain is recleaned by running it through a fanning mill. This process removes weed seeds, foreign matter, broken, small and shriveled kernels, and raises the grade with a resultant increase in price. Since a fanning mill is used at infrequent intervals, it can be owned in common by a number of farmers and save each some investment money. Agricultural schools sometimes own the fanning mill for community use.

FIG. 95.—Rye, vetch, and crimson clover used as cover crop and winter pasture in southern orchard.

FIG. 96.—Wheat used as cover crop in grape vineyard.

Screenings removed from the grain can be ground and used for poultry or other livestock feed.

References to State Bulletins and Circulars.—Ala. 137, 173, 179, 205; Ark. Circ. 153, 176, 185, 199, 201; Ga. 44, 72; Ky. 99, 135, 155; S. C. 163; Tenn. 90, 96, 112; Va. 216; Calif. 364.

Things to Make at Home.—Wagon wheel jack, rack to support grain bags, rack for holding seed samples at school. Ask farmers to suggest other things to make for this enterprise.

FIG. 97.—Most of the hemp in the United States is cut with self-rake reapers, leaving it in gavel on the ground. After drying it is either cured in shocks, to be retted later, or, in the North, spread for retting immediately. (U. S. Dept. Agr.)

HEMP ENTERPRISE

The management of this crop is similar to that of cane and somewhat similar to the small grains in cultural management. Hemp is an annual plant and must be grown after spring frost and before fall frost. It has a rank growth reaching a height of eight to twelve feet. Two kinds of flowers are borne upon separate plants. The staminate plants are less branched than the pistillate plants and their fiber is more valuable.

Soil and Regions.—Any good corn soil will produce a crop of hemp, but in Kentucky and Tennessee it is chiefly grown on the blue-grass soils of the central parts of those states where limestone formations are found. Rich organic soils produce increased yields. In America the waste parts of the plant are usually left in the field and the fiber and seed only are removed. In this way the drain on the soil is very light.

Seeding is done at the rate of five or six pecks per acre, just before corn-planting time. This should be on well prepared soil, but if the ground has been

plowed the same spring the seeding should be followed with a roller to make the soil firm again.

As the growth of the plants is very rapid, they soon smother out any weeds and no trouble is likely to be found from this source.

Harvesting.—When the first seed begins to ripen, about 100 or 110 days from seeding time, the crop is cut, if wanted for fiber, but for seed it is left until a larger proportion of the seed is ripe. The methods of harvesting are varied to suit the rankness of growth. Heavy, thick stems are usually cut with a corn knife, and the crop is laid in piles on the ground to ret or rot. If the stems are not so coarse, a reaper or self-rake mower is preferred. After exposure for a few weeks to the rains and dews, the stems are tied in bundles and put in shocks or small stacks, or, as usually practised in America, the stems are broken in the field and the waste parts are not hauled in. The fiber is tied in bundles for marketing.

A better grade of fiber is produced when the retting process is carried on under water in a stream, but this method is much more expensive as more handling is required.

The yield may be from six to twelve hundred pounds of fiber (Fig. 97) or from fifteen to twenty-five bushels of seed per acre. In the old world the seed is extensively grown, and oil is extracted from it by pressure. It contains thirty to thirty-five per cent of oil, which is used in cooking and making salads. The poor grades are used for burning and soap making. The leaves and stems of hemp also produce a resinous product used for making intoxicants. The fiber is used for rope, cordage, twine, carpet making and other purposes.

SORGHUM ENTERPRISES

By Edwin B. Nelms, B.L., B.S.

Oklahoma State Supervisor Vocational Agricultural Education

Analysis into Jobs.—This group of enterprises includes grain sorghums such as kafir, durra, broom-corn, and sorgo or sweet sorghums. The following list of jobs includes the main teaching units in each of these enterprises. References are to U. S. Farmers' Bulletins.

1. Determining possibilities with sorghums. 1147. U.S.D.A. Bul. 1260.
2. Choosing the crop and the variety. 793, 958, 965, 1147, 1158, 1162.
3. Deciding on soil, field, and area. 1137.
4. Growing a cover crop; providing organic matter. 1137.

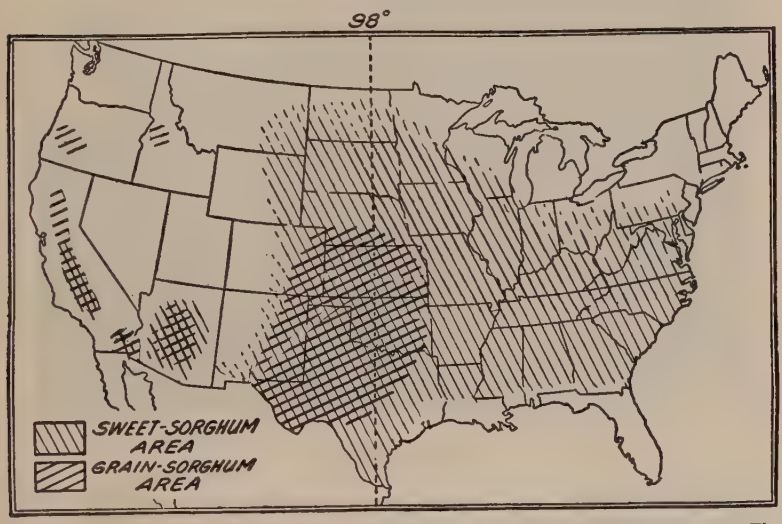

Fig. 98.—Outline map of the United States, showing the principal sorghum areas. The principal grain-sorghum regions, besides the southern Great Plains, include the Salt River and Yuma Valleys in Arizona and the Imperial, San Joaquin, and Sacramento Valleys in California.

5. Improving seed; selecting in field; storing seed.
6. Testing and treating seed before planting.
7. Preparing soil for planting. 972, 1163. U.S.D.A. Bul. 1175.
8. Planting the crop. 972.
9. Cultivating the crop. 972. U.S.D.A. Bul. 1175.
10. Controlling enemies. U.S.D.A. Bul. 1175.

11. Harvesting the crop. 958, 972.
12. Feeding, storing, and marketing. 972, 1158.
13. Keeping records. 511, 572, 782, 1182.

Job 1. Determining Possibilities with Sorghums

Conditions Usually Found.—(1) Grain sorghums are considered among the most profitable crops for forage and grain in the drier parts of many states. (2) Sweet sorghums are profitable in moist climates where the warm season is long enough. (3) Grain sorghums are growing in popularity in arid regions.

Aims.—Students should consider these crops in relation to other farm enterprises. (2) They should know the uses and market possibilities of growing these crops in their own soils and climates.

FIG. 99.—Projects with feterita and mung soybeans, side by side. (Eustace McCarty, student, Oklahoma.)

Problems for Study and Discussion.—(1) Find what farmers of your region grow grain sorghums or other sorghums and what uses are made of them.

2. Ask them for their opinions and experiences regarding the advisability of growing these crops.
3. What are the costs of production?
4. What profits have they made?
5. What insect pests or plant diseases have they encountered? How serious?
6. To what extent is the growing of these crops increasing or decreasing? Why?
7. What are the effects of sorghums on soils as compared with other crops?
8. How well do sorghums fit into a satisfactory system of crop rotation?
9. What machinery or other equipment is necessary in the production, harvesting and storing these crops?
10. How much of this equipment is available in your region?
11. What use would you make of this crop?

12. If fed to animals for market or for marketable products, where would you market these products?
13. Outline the area of America especially adapted to each of these crops. Indicate the additional area in which they are grown with more limited success. In which of these areas are you?
14. Ask growers concerning the relative value of grain sorghums and corn, of sorghum silage and corn silage.
15. To what extent are millets grown in your region?

Forage from Sorghums.—The sorghums are of major importance as a forage crop in a considerable portion of the United States. The grain sorghums are the principal feed crop in several states and in large areas of others. (Fig. 98.)

FIG. 100.—Alternate rows of black-head kafir and cowpeas. A 40-acre project of Louis Derr on upland red sandy loam. Entitled "legumes for upland." (Oklahoma.)

Notwithstanding this fact, relatively little information has been presented in school texts on these crops. Their scope and value have been steadily increasing for the past several years. The scope of the sorghums for forage includes not only the grain-sorghum area but much additional territory throughout the south half of the United States and some areas in other sections.

The grain-sorghum crop for grain alone in 1926 was reported by the United States Bureau of Statistics to be 4,410,000 acres yielding 100,710,000 bushels of grain, and represented at current prices, which were much lower than in preceding years, a value of fifty-five millions of dollars.

The leading states in order were Texas, Oklahoma and Kansas. All other states combined grow less than half a million acres.

Compared with corn, the grain sorghums are a new crop in the United States. They were almost unknown until twenty-five or thirty years ago and have been grown in a rather haphazard way until more recent years. Such improvements have been made in varieties, in methods of production, and in their use and marketing that they are now recognized as the most profitable crop that can be grown in regions having climatic conditions too hazardous for the production of corn.

Feeding values are found to compare favorably with corn and other grains. The sorghums as a whole are considered 90 per cent as valuable as corn. The feeding value of the forage is much improved by legumes. (Figs. 99 and 100.)

Yields of 40 to 60 bushels per acre are common even in areas of very limited rainfall and yields of 100 bushels to the acre are not unknown.

These yields are far above the average of 23 bushels, which low figure is due partly to the fact that some of the grain sorghums thrive under such unfavorable climatic and soil conditions and produce under such adverse conditions that many people have the idea that they do not require the care usually accorded to growing other crops. The fallacy of this has been demonstrated beyond a question by the experiment stations of the several interested states and by many of the thousands of farmers who now make this one of their principal crops.

Sorghums for syrup are grown over a widely distributed area. About one-half million acres were grown in the United States in 1926. The average yield per acre of about 90 gallons produced nearly 46 million gallons, valued at 85 cents a gallon. The ten leading states in order of production for 1926 were Kentucky, North Carolina, Arkansas, Alabama, Tennessee, Texas, Mississippi, Missouri, Georgia, and South Carolina.

Broom-Corn Regions.—The chief states for the growth of broom-corn are Oklahoma, Missouri, Kansas, Illinois, and Nebraska. Broom factories are found in many states and local crops are grown to supply them.

Job 2. Choosing the Crop and the Variety

Conditions Usually Found.—(1) The different types or groups of the grain sorghums have different moisture and temperature requirements and some thrive in higher altitudes than others. (2) A particular variety is usually preferred for each region, but occasionally several varieties are grown.

Aims.—(1) Breeders and students should learn to choose between different types and varieties for the different reasons that render them most profitable in that region. (2) They should understand the advantages of the region for the group and variety chosen. (3) They should understand the advantages of one variety for the farm and for the region. (4) They should also understand the advantages of different varieties for successive plantings as the season advances

Problems for Study and Discussion.—(1) Ask local farmers to compare the different types of grain sorghum, giving their preferences.
2. What groups are the most common in your region?
3. What special variety is considered best adapted in your immediate locality?
4. Compare the yields of the most popular variety with others.
5. Which makes the highest average yield over a period of several years?
6. What use is made of this crop in your community?
7. Which gives the best and cheapest returns when fed?
8. Compare the different types and varieties of grain sorghums grown in America, and state their special adaptations.
9. What are the objections to growing both sweet and grain sorghums on the same farm? What are the advantages?
10. How can these objections be overcome?
11. What are the advantages of growing only one variety?
12. Why should experiment stations, rather than farmers, try new varieties?
13. Debate the question of the superiority of different varieties for your region.

Activities.—(1) Collect and mount pictures from bulletins and catalogs of the different types and varieties of these crops. (2) Collect and mount on beaver board samples of heads of the different types and varieties.

Classification.—The general divisions of sorghums are saccharine and non-saccharine.

The saccharine or sweet sorghums are so termed because they contain in the cells of their tissues a large amount of sap or juice rich in sugar. They are also called the sweet sorghums or canes. They are grown primarily for forage and for the manufacture of syrup.

The non-saccharine or grain sorghums comprise a large variety of plants which, in this country, are grown almost entirely for feed, including both grain and forage for livestock. Some varieties are also grown for pasture.

- Classification of Sorghums
  - Sweet Sorghum
    - Black Amber
    - Red Amber
    - Orange
    - Sumac
    - Honey
    - Colman
    - Folger
    - Gooseneck
  - Grain Sorghum
    - Darso
    - Kafir
      - Blackhull
      - White
      - Red
      - Pink
      - Dawn (Dwarf Blackhull)
      - Sunrise (Early Blackhull)
    - Milo
      - Yellow
        - Standard
        - Dwarf
      - White
        - Standard
        - Dwarf
    - Feterita
      - Standard
      - Dwarf
      - Spur
    - Durra
      - White
      - Brown
    - Kaoliang
      - Manchu
      - Barchet
    - Shallu
    - Hegari
    - Jerusalem corn
  - Grass Sorghum
    - Sudan Grass
    - Tunis Grass
  - Broom-corn
    - Standard
    - Dwarf

Group types and varieties have not yet become so distinct and definite as in corn, cotton, and other staple crops, but it is necessary to make some sort of classification or grouping that will serve the purposes of the farmer and the agronomist.

Sorghums belong to the grass family and have all originated from species grown in Africa and Asia. Owing to the fact that varieties frequently cross-pollinate in the field, new varieties are constantly arising. Such varieties, being more or less intermediate in character between the parent varieties or groups, are difficult to classify. Numerous hybrids and mutations are represented in the varieties now grown.

FIG. 101.—Vocational agriculture student selecting kafir seed in his project field.

We are chiefly concerned with certain groups that have been proven to have the greatest economic value in our country. Among these are the kafirs; milos; feterita; several varieties of the sorgos, or sweet sorghums; broom corn; grass sorghums, as Sudan and millets.

Structure.—The sorghums have erect stems and produce their seed at the top. The stems are relatively thick and coarse. The interior of the stem is filled with a pith which varies from dry to very juicy; the internodes (spaces between joints) are comparatively long. A leaf is produced at each joint and the leaves are arranged alternately. The sheaths are open, although in some cases, strongly overlapping. The roots are fibrous and abundant. Leaves, long and slender to relatively broad. Heads vary greatly in shape and structure in the different types. They can be either self-pollinated or cross-pollinated. When cross-pollination occurs, it is usually due to the pollen grains being carried by the wind. The sorghums are largely self-pollinated.

Kafirs.—This group includes the most important and best known grain sorghums grown in the United States. The kafirs are characterized

by having little juice in the pith. The juice is sweet to subacid. The internodes are short; the stems are fairly thick; the sheaths are strongly overlapping; leaves wide and fairly long, from twelve to fifteen in number; heads erect, compact and cylindrical; seeds somewhat hard in texture.

Blackhull Kafir.—This type is more commonly called "Blackhull White" and is the most important, not only of the kafirs, but of all the grain sorghums grown in this country. (Figs. 101 and 102.) Not until the ranchmen and farmers of the Southwest commenced to grow it did it attract very much attention. During the last thirty years it has gradually received increased recognition, and is now considered one of the most important staple crops in western Nebraska, Kansas, Oklahoma and Texas. It is also grown considerably in eastern Colorado and New Mexico, although it does not seem to be as well adapted to the latter section as are some types of milo and durra.

FIG. 102.—Showing desirable type of interior of kafir head.

Results seem to indicate that blackhull kafir is superior to any other grain sorghums in the eastern part of the grain-sorghum belt, though Yellow Milo and Darso, which has been developed in Oklahoma, are superior under some conditions. Blackhull kafir usually yields better than either red or white kafir; does not lodge or "go down" as do Jerusalem corn, feterita, and the Kaoliangs; does not shatter as do white kafir and Jerusalem corn; has erect heads, a characteristic not possessed by milos and Jerusalem corn; and does not sucker as do many of the grain sorghums.

This is the type of the kafir in most general use and when the term kafir is used, the blackhull is usually meant.

The Durras are characterized by having scanty, sub-acid juice; internodes medium in length; stems coarse; plants varying in height from a few feet in the extreme dwarf strains to ten or twelve feet in some of the standard milos and Jerusalem corn; heads inclined or gooseneck in most varieties; seeds large, with kernels soft in texture. These plants have relatively few leaves compared with the kafirs, and consequently are not as valuable for forage production.

Yellow Milo.—This type was probably introduced from Africa between 1880 and 1885. It was first grown in some of the southeastern states, but failed to attract very much attention, and, like the kafirs, it did not reach any importance in this country until it found its way into

the Panhandle of West Texas and Oklahoma. Next to kafir, it is the most widely distributed and extensively grown of the grain sorghums. The present limit of its production is practically the same as that of kafir, but it is grown more than the latter in the extreme West and but very little in the extreme eastern part of the grain sorghum belt.

Yellow milo has dark yellow or yellowish-brown glumes and seeds, varying in different strains from very dark to very light in color. Brown milo, red milo and orange milo are other names for yellow milo, and are practically identical. Yellow milo is the name commonly used (Figs. 103, 104). Milo varies in height from as low as 2½ feet to as high as 11 feet. Dwarf milo is the name given the low-growing strains which have been developed in the regions

Fig. 103.—Typical yellow milo. Head is of desired shape.

of scanty rainfall, and standard milo is the name given to high-growing strains. In humid sections and on rich soil dwarf milo will grow considerably higher than in the dry sections; it will not, however, grow as high as the standard milo. The standard, on the other hand, will not attain as great a height in the dry regions as in the sections of greater rainfall, but will grow higher than the dwarf in the dry sections. There is practically every gradation intermediate between the two strains noted. Since grain production is the chief aim in growing this crop, the dwarf milo is preferred by farmers, and is now almost universally grown in preference to the standard.

The general claim is made by growers that yellow milo is more drouth resistant than kafir. While this may be true, it has not yet been proved. But since it matures from one to two weeks earlier than most strains of kafir it is better able to evade drouth and consequently is more profitably

grown in the driest sections of the grain sorghum belt. Yellow milo has several objectionable features which render it a less desirable crop than kafir: a small amount of forage; inclined or goose-necked heads; stooling or suckering; some side branching; and lodging. Yellow milo suffers more from the ravages of chinch bugs than does kafir, but in all other respects it compares very favorably.

Feterita is characterized by rather slender, medium-tall plants, having more leaves than milo, but less than kafir. The stalks are more slender than either kafir or milo. The heads are erect. The seeds are white or bluish-white and flattened. The glumes vary in color from white to shades of pink, red, brown and black. The height is irregular and varies in different seasons, different sections, and according to the fertility of the soil; from six to seven and one-half feet is a fair average. (Fig. 105.)

Fig. 104.—A winning four-head sample of Milo.

Feterita produces suckers, but not as extensively as milo. It also produces side branches. It usually lodges badly if left in the field after maturity. Feterita matures from ten to twenty days earlier than Blackhull kafir. It yields nearly as much grain as kafir, but considerably less forage.

When feterita and milo are seeded early they mature in practically the same length of time. When late seeding is practised, the feterita matures in a shorter period of time. The later the seeding the greater the advantage in favor of feterita. The later the planting of any of the grain sorghums the shorter the time it takes them to mature, if conditions are at all favorable, but this is especially true of feterita. For this reason feterita is generally found the best variety for planting after wheat or oats.

The fact that it stools badly and that it lodges and shatters very easily and quickly after maturity seriously affects its value as a grain

crop. For hogging-down or for soiling it seems to rank high. It is recommended for those sections where kafir cannot be grown successfully. Even though feterita produces in many instances a higher yield of grain than kafir, its tendency to sucker and lodge makes it a less desirable crop in the eastern part of the grain-sorghum belt for the general farmer whose principal aim is grain production.

The Kaoliangs imported from Eastern Asia offer no advantages over the kafirs, milos or feterita.

Shallu, one of these sometimes offered for sale under the name of "Egyptian Wheat," "Mexican Desert Wheat Corn" and other misleading

FIG. 105.—Class in vocational agriculture studying the characteristics of feterita in field conditions.

representations, is a late-maturing grain sorghum. The large open heads give the impression of large yields, but under the most favorable conditions shallu is inferior to kafir and milo and frequently fails entirely because of the long growing season it requires. The value of shallu as forage is also very slight. It shatters badly and is hard to harvest because the slender stalks are easily blown down. Consequently it is not recommended in the grain sorghum area.

Darso.—This is a grain sorghum of unknown origin, developed by the Oklahoma Station about 1912. It is now in quite general use throughout the grain sorghum section of Oklahoma and adjoining states. It is a leafy, stocky sorghum, red-seeded, drouth-resistant, early-maturing, and very uniform in height. The forage contains a higher percentage of total sugars in the juice than does blackhull white kafir or feterita.

The chemical composition of the grain and the forage is very nearly the same as that of blackhull white kafir. Tests indicate that in feeding value it is about the equal of other grain sorghums. In variety tests of grain sorghums extending over a period of years at the Oklahoma Station, the average yield for darso has been slightly greater than the blackhull white kafir, and more than any other grain sorghum. Being a dwarf plant it yields less forage than blackhull white kafir.

Darso is able to withstand relatively long periods of drouth better than blackhull white kafir. Because of its early maturity, it can be planted later than most of the grain sorghums and still give relatively good yields. Blackhull white kafir has given better results than darso when planted early. In favorable seasons, kafir will outyield darso. Special points of merit of darso are that it will make a better crop than kafir in seasons with less than normal rainfall and that it yields good crops when planted late in the season.

J. B. Sieglinger of the Woodward station of Oklahoma favors darso because it is damaged less by chinch bugs and not bothered by birds so much as kafir.

Hegari is a grain sorghum that is hard to classify as it has characteristics similar to kafir and feterita. It may be a hybrid between these two groups. The grain is slightly different from feterita. The stem and leafiness of the plant are similar to those of feterita.

The Variety to Grow.—The United States Department of Agriculture recommends: "Grow the variety of grain sorghum which is most likely to prove best over a series of years. No one variety will make the highest yield under all conditions. Where there is plenty of moisture and a long, warm growing season, the late-maturing blackhull kafir usually yields more than any other variety. Under drier conditions and in shorter seasons the earlier varieties are surer and on the average outyield the later ones.

"No fixed lines can be drawn showing just where each variety succeeds best. In general, the milos and feterita should be grown on the uplands, at elevations of 3,000 feet or more, and in the drier sections of the grain-sorghum belt. These varieties mature in fewer days and require less moisture than the kafirs. They usually give better results than the kafirs in localities where the average annual rainfall is 20 inches or less. The milos and feterita succeed well in southwestern Kansas, in the Panhandles of Oklahoma and Texas, in eastern Colorado, and in northeastern New Mexico. In southern Arizona and in California, where the crop is grown under irrigation, dwarf milo usually outyields other varieties.

"The kafirs are well adapted to localities which have an average annual rainfall of approximately 25 inches and an elevation up to or slightly more than 2,500 feet. The bulk of the kafir crop should be grown east and south of the territory previously indicated for the milos and feteritas. However, the kafirs do well in much of that territory in favorable season. The early kafirs, Dawn

and Sunrise, are the best varieties to grow. The larger broad-leaved blackhull kafir requires a longer season and more moisture than the early varieties. It should be grown farther east and south, at lower elevations and where the rainfall is greater." .

Sweet sorghums have been improved from native varieties and there are several of each of three types; orange sorghums, sumac sorghums and gooseneck sorghums. Another type known as amber matures in about one hundred days from seeding time. It is only five to seven feet in height, with rather loose black heads. Red amber has red seed heads.

Varieties of Broom-Corn.—There are two varieties or types of broom-corn: (1) standard broom-corn produces broom-straw tops 20 to 30 inches long, and grows to a height of 10 to 12 feet. It is grown most in humid regions. (2) Dwarf broom-corn produces straw 12 to 24 inches long and grows to a height of only 4 to 6 feet. It is best adapted to dry regions.

Job 3. Deciding on Soil, Field, and Area

Conditions Usually Found.—(1) The importance of establishing a fixed rotation is often recognized. (2) Growers too often fail to select the best soils for these crops. (3) More commonly the grain sorghums and broom-corn are grown on the best soils of the farm.

Aims.—(1) Students and growers should learn to establish rotations that help to maintain fertility, using crops that also return an immediate profit. (2) They should learn to choose favorable soils, and should know the importance of planting enough of the crop to allow for unfavorable weather conditions.

Problems for Study and Discussion.—(1) Talk with several growers regarding their rotation systems involving these crops.

2. Make a list of the rotations which you consider poor and another list of the best ones.
3. How do preceding yields influence the choice of a field?
4. What crops should precede sorghums in your region?
5. Find what areas are devoted to each of these crops.
6. Study these areas and see which would and which would not fit into the farm rotation systems for your farm.
7. Talk with farmers regarding the choice of soils for these different crops. Do their practices agree with their answers?
8. To what extent do farmers consider these crops exhausting to the soil?
9. To what extent would you allow the price of the products last year to influence you in the acreage to be planted this year?
10. When you have a fixed rotation but wish to reduce the acreage for any reason, what crop would you substitute for a part of the sorghum crop?
11. What local soils are rich enough and suitable for producing a profitable crop?

Avoiding Poor Soils.—Sweet sorghums are frequently grown on soils which are so low in fertility as not to respond well to corn or to small-grain crops. This practice may give poor returns, and is certain to leave the soil so depleted as to be harmful to succeeding crops.

Choosing Soil.—These crops require considerable potash and should have rather fertile soils, such as medium or heavy loams. Light soils are

not well suited to the growth of sorghums and millets. They are heavy feeders and respond well to abundant supplies of plant food in the soil.

The Rotation.—If the crop preceding sorghum or millet has been fertilized, a residue may remain in the soil which these crops can use. The rotation should be considered carefully (Fig. 106). It is bad to grow the crop several years on the same field. The method to be followed in harvesting the crop may influence the grower in choosing the field. The machinery should be considered before planting.

Soils in Dry Regions.—The admission of rainfall to the surface of the soil must be considered in dry regions. A very heavy clay surface soil will not allow heavy rains to enter the soil readily and much of the

Fig. 106.—Darso following alfalfa. Vocational student project in Oklahoma.

water may be wasted by run-off. Heavy soils are also apt to bake and crack, exposing the roots of the plants in dry hot summer weather. Medium, sandy, or silty loams are usually preferred in farming regions. The subsoil must not be light, or it will allow too rapid downward percolation of water.

Job 4. Growing a Cover Crop. Providing Organic Matter

Young growers in regions where this job is important should refer to the corresponding job in the corn enterprise.

Job 5. Improving Seed. Selecting in Field. Storing Seed

Conditions Usually Found.—(1) Too little care is usually given to the selection of good seed for grain sorghums. (2) Few farmers practise field selection of seed: these, however, find the practice profitable. (3) Seed plots for improvement of sorghums are seldom found.

Aims.—Young growers should learn the advantages and methods of field

selecting of sorghum seed; the advantages of judging heads; and the cost and methods of securing improved seed from other sources. Good methods of storage should be understood.

Problems for Study and Discussion.—(1) Inquire among farmers to learn which ones believe that field selection of sorghum seed would improve the crop.

2. Study a field and see what variations you find in the sizes, shapes and weights of heads, strength of stalks, amount of fodder, freedom from disease, tendency to lodge, and other points.
3. From this make a list of the points for which you would watch.
4. When should field selection of seed be done?
5. Calculate the cost of selecting enough seed for a field of average size.
6. What is the rate of seeding per acre? What is the probable cost of field selection of seed for planting an acre? What are the probable returns for this work?
7. What is the influence of an adjacent field of sorghum on the seed?
8. Why should the direction of the wind be considered in this job?
9. What are the advantages of a sorghum seed plot?
10. What is roguing a seed plot? When should it be done?

Fig. 107.—Vocational student selecting seed in his field of kafir.

11. What farmers of your neighborhood buy seed? Trace the sources of such seed and draw your conclusions.
12. Give points in judging seed heads.
13. Explain how the purity and potency of a selected head may be tested before using it in the seed plot.
14. Locate fanning mills in your region which could be used for recleaning sorghum seed. What do they cost?
15. Calculate the time required for recleaning enough seed for a field of average size.
16. Get, if possible, actual figures of costs and returns from similar growths of field-selected seed and those from "field-run" seed; compare results.
17. Why is field seed selection more effective in the sorghums than in corn?
18. Why should seed from the tallest, most vigorous plants not be selected for next year's seed?
19. Find what methods are used in curing and in storing sorghum seed. Compare these methods.
20. Why should seed be well matured before it is cut from the stalks?
21. What conditions are favorable for curing?
22. Under what conditions should the heads be cured?
23. Describe the carbon-bisulfide method of treating the heads to destroy weevils and moths.
24. Tell how to store to prevent attacks of such enemies and of mice and birds.

Activities.—Practise field-selection of seed for the variety preferred. Calculate

the quantity required for an average field. Mount the most typical heads on pulp board for exhibit. Treat seed for moths with carbon bisulfide.

Cross-Pollination.—All types of sorghum and broom-corn readily cross-pollinate with each other, the pollen being carried by the wind. Growing two types or varieties too close together will allow them to cross and become impure—not true to type. But some of the plants would naturally self-pollinate.

Selecting Seed in Field.—Sorghums should be improved by field selection of seed. Any grower can easily improve the strain in this way (Figs. 107 and 108).

For fodder, slender stalks with abundant leaves are preferred. For grain, size and weight of head and seeds are important. For syrup, the

FIG. 108.—Selecting heads of black amber cane for seed. Vocational agriculture project.

juice, size of stalk, and length of joints are considered. For northern regions, early maturity is necessary. Broom-corn should have abundant and uniform brush. (Review the job on field selection of seed in the corn enterprise.)

Score Card.—The accompanying score card for growing sorghums can be used to good advantage in preparing for field selecting of sorghum seed. Many of the points apply nearly as well to sweet sorghum.

Judging Heads.—Points in the score card may be used as guides in judging heads either before or after selecting in the field. Special attention should be given to purity of seed as indicated by uniformity in size and shape and color of kernels, shape and habit of head to suit the variety.

Using a Sorghum Seed Plot.—Many agricultural students and others have found it profitable to improve seed by the use of special seed plots. The practical methods of seed improvement in a seed plot are (a) by mass selection, and (b) by individual plant selection.

In mass selection, a large number of heads appearing to have the desired characteristics are used for planting. The undesirable plants and

heads are rogued out, and this process is followed from year to year in a plot sufficiently isolated to prevent cross-pollination from other plants or fields. Much may be accomplished in this manner.

In individual plant selection, a single head having the desired characteristics is selected. From the progeny of this head are selected other heads having the desired characters. The best of these are planted and so on. Records can be kept of the different heads and a sort of pedigree established from which may be judged the fixation of different characters. It is in this manner that the most of our varieties have been established, if, indeed, they may be said to be established. Vast improvements have been made in yields and other important characters.

Cleaning Seed.—After sorghum heads have been threshed the seed can be greatly improved in quality by the use of a fanning mill to remove chaff, light seeds, and gravel.

Curing Heads for Seed.—Mature seed only should be selected. Stalks saved for seed are cut near the ground. The heads should be cured by placing them in small shocks or standing along a fence. Plenty of air is favorable for curing. When the heads are removed a few weeks later they should be placed in a dry barn, well spread, never in masses.

Storing Seed.—Some growers store the heads before threshing while others thresh the seed when cured to reduce storage space and damage from mice and moths. In either case the seed should be kept in tight barrels or cans, well covered. The mass should be examined after a few weeks and if necessary aired again and placed in another container. Heating and molds must be prevented.

Treating for Weevils and Moths.—In most sorghum regions these insects are very injurious to stored seed. When the seed is placed in an air-tight container put a dish containing a little carbon bisulfide on top of the seed and cover the container for a day. This will kill moths and weevils that may be in some of the seed. A second treatment should be given two or three weeks later if the weather is warm. Use at the rate of two ounces to fifty cubic feet of space.

BLACKHULL WHITE KAFIR, MILO, DARSO
SCORE CARD

Uniformity—Heads should be uniform in shape, size and type 5

Length of Head—Standard kafir, 10–12 inches; dwarf kafir, 9–11 inches; milo, 7½ to 8½ inches; Darso, 10–12 inches 10

Circumference—Standard kafir, 7–8 inches; dwarf kafir, 6–7 inches; milo, 8½ to 9½ inches; Darso 7½–8½ inches 10

Structure of Head—Blackhull white kafir: the center stem should be at least three-fourths as long as the head. The internodes or seed stem sections should occur at regularly decreasing intervals and be not less than

five in number—even distribution, uniformity in length and close setting of the joints on seed stems being desirable. Milo: center stem should be continuous. Spikelets or seed stems should occur regularly—even in distribution, uniformity in length and close setting of the seed stems being desirable. Darso: the center stem should be at least three-fourths as long as the head 15

Seed Stem Branches—Well proportioned to length and size of head, no open spaces, each place for a seed being filled 10

Color—Kafir—White grain with pink speck on tip, enclosed in a black hull. Milo—varies with variety, milk-white grain with black hull, and reddish-like grain with brown hull. Darso—brown grain, enclosed in reddish-brown hull 5

Size and Shape of Kernel—Should conform to the standards of its kind 10

Shattering—Kafir should not shatter easily. Milo should not shatter. Darso should not shatter 5

Exsertion—Head must be pushed clear of boot 5

Seed Condition—Sound, pure and mature 10

Base—First seed stems not too long, thickly set and well filled close up to the main stem. An open base is undesirable 10

Tip—Kafir—Not too tapering. Tip seed stems should not be more than one-fourth as long as head. Milo—Rounding. Darso—Not tapering. Each should be well filled with sound and uniform kernels 5

Totals 100

Job 6. Testing and Treating Seed before Planting

Conditions Usually Found.—(1) Most farmers do not test nor treat seed. (2) Poor stands and consequent losses often result.

Aims.—Breeders should know the advantages of testing and treating seed; learn the best methods of doing these jobs.

Problems for Study and Discussion.—(1) What farmers of your region test grain-sorghum seed before threshing it or before planting?

2. Test fifty heads by the rag-doll method and record the time required to do this.
3. How many acres would this plant? Find the cost per acre.
4. From the percentage not germinating and of low vitality, estimate the probable loss from planting untested seed.
5. Write a description of a good method of testing seed.
6. Why test before threshing?
7. In what kind of room should the testing be conducted? Give temperature.
8. When is the best time of year for testing?
9. Which should be done first, testing or selecting by the score card?
10. At what temperature should tests be conducted?
11. Why is it necessary to have a higher temperature for testing the germination of the sorghums than for testing wheat?
12. How does disease affect the vitality of seed?
13. How can seed be treated before planting to control smut and to increase germination?
14. Describe a good plan for doing the treating.

Activities.—Test seed by the rag-doll method described in the corn enterprise. Treat seed before planting, as described here.

Testing Sorghum Seed.—Less seed is required if it is tested before planting. The heads should be tested before threshing so that those falling low in vitality may be fed to livestock. Perfect germination should be the standard. Thinning the stand may be avoided by planting the exact number of kernels desired. A better stand will be secured in the field and replanting of the field will be unnecessary. A more even germination of the young crop will be found. This allows the farmer to cultivate or harrow the field much earlier and weeds can thus be kept in control more easily. The testing process calls the farmer's definite attention to imperfections which otherwise might not be noticed. A more even growth in the field throughout the summer and a more even maturity at harvest time are assured.

Using the Rag-Doll Method.—When heads of sorghum or broomcorn are tested before threshing, the undesirable heads can be removed. The rag-doll method described in the corn enterprise should be used. Ten or more kernels from each head should be used.

Treating Seed before Planting.—Poor stands of sorghum often occur because of attacks of molds and fungi of different kinds during the germination period. When the germination period is prolonged by unfavorable temperature and moisture conditions, the reduced germination is very serious.

The Goodwell Station, Oklahoma, shows that treatment of seed with either Bayer's dust or copper carbonate greatly improves germination. The cost is negligible, the application simple, and the increased returns great. Seed may be treated by putting the copper carbonate or Bayer's dust at the rate of 4 ounces of the mixture per bushel in a can or other inclosed vessel and turning until all seed are coated with all the dust that will adhere to them. Care should be exercised by the operator to avoid inhaling the dust. The chalk-white seeds seem to be more susceptible to the rots during the process of germination than others.

The earlier the planting the more necessary is the treating for improving the stand. The copper-carbonate treatment also serves to prevent smut in the crop produced.

Job 7. Preparing Soil for Planting

Conditions Usually Found.—(1) Very careless methods in preparation of soil are found. (2) Some growers plow, disk, and harrow their fields well and find that good methods pay.

Aims.—(1) Students should understand the effects of a rather long harrowing period before planting. (2) They should understand management of the soil, depth of plowing, decay of green manure, proper ridging in windy regions and other methods of preparing a good seed-bed.

Problems for Study and Discussion.—(1) What are the methods employed by the most successful growers in your community?
2. Why should there be a difference in the time and method of preparation of soils of different types?
3. What method should be employed with yours? Why?
4. What implements should be used in preparing a good seed-bed?
5. Compare fall and spring plowing for sorghums in your region.
6. When soil is plowed in the fall, how early should it be disked or harrowed in the spring? Why?
7. What is meant by "bare-fallow before planting"?
8. Explain how several harrowings will destroy the weeds and weed seed.
9. How does frequent harrowing save water and warm the soil?
10. How many farmers use several weeks for harrowing the soil before planting?

Fig. 109.—Student-farmer plowing field for planting sorghum.

11. Ask farmers who have used the bare-fallow period if it makes the weeds less troublesome during growth of the crop.

Activities.—Test the effects of several harrowings before planting on the abundance and growth of weeds by comparing with a plot not so harrowed.

Fall or Spring Plowing.—The main steps in the preparation of soil for growing sorghums are similar to those for corn (Fig. 109). A review of the methods suggested in the corn enterprise should be made. In regions where a suitable crop can be left on the soil through the winter, it is usually best to plow in early spring rather than in the fall. Spring plowing should be early enough so that there will be ample time for the soil to become well settled before planting.

Harrowing.—Between the plowing and planting dates the soil should be disked once and perhaps harrowed enough to control weed growth. Sorghum soil needs to be settled better and its weeds must be more thoroughly killed than for corn. Seed do not germinate well if the bottom

soil is too loose. Weeds are a very great annoyance in a young growth of sorghum.

Saving Moisture.—In dry regions there are several practices in tillage which will aid in saving the moisture from the rainy season until it is used by the growing crops. These may be considered under the following heads: (1) summer fallow; (2) growing crops in rows to allow tillage between rows; (3) the maintenance of a dust mulch or granular-clod mulch during much of the time when the crop is not actually covering the soil.

Other factors of importance in this connection are ridging the soil to prevent blowing and surface cracking, and winter protection to conserve the moisture which comes in the form of snow.

Job 8. Planting the Crop

Conditions Usually Found.—(1) Farmers understand and practise good methods of planting. (2) Poor stands sometimes result from careless methods. (3) Fertilizers are seldom used even when they would improve the yields.

Fig. 110.—Furrow planting of grain sorghum with combination lister and planter.

Aims.—Students should understand the best methods of planting to follow under different seasonal conditions and know the methods of planting for different purposes.

Problems for Study and Discussion.—(1) What are the planting methods employed by the most successful growers in your community?

2. Compare the results of these methods.
3. What influence has the time of planting on the germination and growth of the plants?
4. Why can you plant earlier on a light soil than on a heavy soil?
5. How does the time of planting influence the date of maturity?
6. Give the rates of planting of these crops for forage; for other purposes.
7. What implements are used in planting these crops? (Fig. 110)
8. Under what conditions are they sown broadcast?
9. What are the best depths of covering of seed for these different crops and for the several kinds of soil?
10. What companion crops may be grown with sorghums?

11. Give methods of growing them.
12. For what uses are they grown?

Activities.—(1) Test the working of planters to determine their accuracy and uniformity of planting. (2) Conduct a trial to compare two rates of seeding.

Drilling Sorghum Seed.—Ordinary corn planters may be used in planting sorghum seed. Special plates for small seed should be used. Space the rows about three and one-half feet apart and the plants from six to eight inches apart in the rows. Seed are sown about two weeks after the earliest corn time planting and when the soil is almost warm enough for warm garden crops. Two weeks after the last frost is better than when the soil is cold. Very slight covering of the seed is advisable for heavy soils and for wet climates. In dry climates and dry soils deeper covering, to an inch or over, is desirable. Bare-fallow before planting warms the soil.

Sowing Broadcast.—Sorghum seed is often sown broadcast for hay or fodder. It may be mixed with cowpeas or soybeans and sown thick. Grain drills or broadcasting methods may be used for this. Such mixtures produce very good forage for livestock. The legumes add greatly to the feeding value for young stock and for milk production.

Manuring.—The Oklahoma station has shown that manuring has given increased yields of grain sorghum. The sweet sorghums all draw heavily on the plant-food supply in the soil. Soils become impoverished unless maintained in some way. Yields are certain to decrease unless fertility is considered. Commercial fertilizers are often used with profit in humid regions, particularly for sweet sorghums.

FEEDING VALUES IN AND FERTILITY REMOVED BY SORGHUMS AND MILLETS

NAME OF FEED	DRY MATTER IN 100 LBS.	DIGESTIBLE PARTS IN 100 LBS.		FERTILITY IN 1000 LBS.		
		Protein	Carbohydrates (+fat × 2.25)	Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)
Broom-corn fodder	90.6	0.6	47	10.2		
Feterita grain	88.9	10	71	20.0	5.7	3.1
Feterita head chops	88.8	7	64.9	17.8		
Kafir grain	88.2	9	71	17.8	5.7	3.1
Kafir head chops	87.5	6.1	61	15.5		
Kafir dry fodder	91	4.1	48.8	14.2		
Molasses, black strap	74	1	58.5	5.1	2.4	31.6
Milo grain	89.3	8.7	70.7	17.1	7.8	4.3
Milo fodder	88.9	1.9	42.6	19.2		
Sorghum grain (sweet)	87.3	7.5	72	14.7	8.2	3.3
Sorghum fodder, dry	90.3	2.8	49.3	11.8		
Sorghum bagasse, dry	88.7	0.5	53.7	5.4		

Job 9. Cultivating the Crop

Conditions Usually Found.—(1) Growers usually cultivate this crop as well as they do a corn crop. In some cases the crop is badly neglected. Very few practise cross-harrowing.

Aims.—The student should understand the best methods of conserving soil moisture; what plans of cultivation are best; and how to economize labor.

Problems for Study and Discussion.—(1) What are the methods of cultivation practised in your community?

2. Which of these methods seem to meet the needs of soil and moisture conservation?
3. How may the effects of hot winds be reduced to a minimum?
4. Under what conditions can cross-harrowing be practised?
5. What are the benefits of cross-harrowing before and after germination?
6. Under what conditions should cross-harrowing be avoided?
7. Compare level and ridge cultivation. Give examples.

Activities.—Employ different cultivation methods on different plots and compare results.

Fig. 111.—Cultivating red top cane.

Cross-Harrowing Sorghums.—When soils have been prepared by harrowing several times for a few weeks before planting, the control of weeds in the field is much easier than when the preparation is poor. Cross-harrowing of the field just after planting and several times after the sorghum is well up may be practised on smooth, level fields without serious damage to the sorghum. In cases where the soil is very stony or cloddy the plants may be covered or injured by harrowing.

The advantages of cross-harrowing over early row tillage are given: (1) Several rows may be cultivated as easily as one. (2) Harrow teeth work closer to the plants. (3) Weeds are all killed without hand work. (4) Tillage may begin when plants are smaller. (5) Capillary moisture is saved better. (6) Free water enters soil better.

Cultivating the Rows.—(Fig. 111). After sorghum is too tall to harrow, cultivation between rows should begin. The chief purpose is to control weeds. The Oklahoma Station showed an advantage of nine and one-half bushels of grain per acre on soil from which weeds were kept

scraped over that upon which weeds were allowed to grow. Weeds are the most destructive enemy to dry farming if not to all crop raising.

Controlling Moisture.—Naturally the water which falls in the form of rain may run off into streams, or may be taken up by the soil, or may be evaporated into the air by wind and sun. That which enters the soil is practically the only part of the rainfall which may be used by plants in growing crops. The problem of the grower under dry-farming conditions is to control the water which enters the soil. He desires to prevent the water from seeping away out of the reach of roots of plants. He also wishes to hold the water in the form of capillary moisture so that the roots of plants may absorb it for growth. He wishes to reduce weed growth so

Fig. 112.—Vocational agriculture student studying smut and calculating percentage in milo maize heads.

as not to lose moisture in that way. He wishes to reduce evaporation from the surface of the soil. The evaporation may be controlled to some extent by a surface mulch, either of loose soil or of fine clods. Windbreaks may reduce the wind exposure and thus reduce evaporation. Shading the surface by growing plants will reduce evaporation.

Job 10. Controlling Enemies

The enemies of sorghums and broom-corn when present are similar to those of corn. (Fig. 112.) Reference is made to the corn enterprise.

Job 11. Harvesting the Crop

Conditions Usually Found.—(1) The purpose for which each crop is grown determines the method of harvesting. (2) The stage of growth for harvesting depends upon the use to be made of the crop.

Aims.—The proper time of harvesting and the most improved and economical methods of harvesting and curing under various conditions should be understood.

Problems for Study and Discussion.—(1) What are the methods of harvesting practised in your community?

2. How is the time of harvesting influenced by the use to be made of the crop? (Fig. 113.)

3. Discuss characteristics of the grain sorghums which often make them hard to cure properly.
4. How does improper curing affect the quality of grain?
5. If grown for silage, in what stage is the crop harvested?
6. Under what conditions would the crop or any part of it be harvested with livestock?

FIG. 113.—Feterita project. Estimating maturity before harvesting for grain.
FIG. 114.—Threshing grain sorghum in Oklahoma. Vocational agriculture students were interested in this crop.

7. What improved methods of harvesting are found locally?
8. Describe new methods and give conditions for their use.

Activities.—Test different methods of cutting fodder and determine which is most rapid and most economical. Likewise test methods of topping. Practise tabling and harvesting broom-corn.

Grain sorghums are harvested in much the same way as corn. Hand or machine methods are used with this crop, and shocking usually follows cutting. If the grain is to be threshed, the heads are removed by hand

while the stalks are standing; or if in bundles, by a knife lever device on the side of the wagon box. The heads are run through a grain thresher (Fig. 114). Some farmers feed the heads of bundles into the thresher without cutting them off and withdraw them after the grain is stripped.

Broom-corn is harvested by hand by cutting the heads from stalks in the field before the seed are mature. There is more trouble with standard broom-corn than with dwarf. Before the heads ripen, two rows are broken past each other, or a few plants are thus broken and the tops of others laid on these. The process is called "tabling." For this the stalks are bent over, two or three feet from the ground. A little later the brush is removed by cutting a few inches below the best of the heads. These are laid on the table to cure and later hauled in for threshing. For the

FIG. 115.—Grinding sorghum cane and boiling down sap for molasses. Indiana Student Project. (J. C. Allen.)

removal of seeds revolving cylinders are used instead of ordinary threshers. The brush is further cured after threshing.

Broom-corn must be baled very carefully. Brush must be laid straight in the bale to avoid crumpling. The stem ends should be even to make a smooth bale. Use plenty of cross wires to prevent the end wires from slipping off. Store bales in a dry shed to avoid damage from rain and snow.

Sweet sorghum to be used for syrup is usually stripped of its leaves by hand before or after cutting down the stalks. The cutting is done by hand with corn knives, by sled cutters or by large corn harvesters. The heads are removed by different methods. The stalks are then taken to the sorghum mill and the juice is pressed out by heavy rolls.

Syrup Making.—(Fig. 115). This process is divided into three steps: (1) pressing out the juice; (2) clarifying and settling; (3) evaporating and skimming. Two types of mills are often found, two-roller and three-

roller. The latter may remove more than one-half the juice from the cane. This contains many impurities, but part of these will settle to the bottom and are easily removed. Sometimes one pound of finely powdered yellow clay is added to each five gallons of juice to help settle impurities. The juice is next filtered through charcoal. Some impurities coagulate with heat and if they rise to the top may be skimmed off. Sometimes skim-milk is added to the juice to aid in collecting impurities to be skimmed off. Bitter or acid taste may be corrected by use of fresh lime or clear lime-water, added when the juice is hot. Evaporation to the desired degree of thickness is conducted in special pans which cause the juice to flow to prevent burning.

The best syrup is free from bitter taste and scorched flavor. It is of a good thick consistency, and perfectly clear of all impurities.

Job 12. Feeding, Storing, and Marketing

Conditions Usually Found.—(1) Grain sorghums are grown for market and to feed livestock. (2) Sweet sorghums are mostly fed to livestock where grown or used for syrup. (3) Poor facilities for proper curing and storing of the crops often result in losses from molds, insects, birds, and rodents.

Aims.—The feeding value of the grain sorghums; the best methods of handling, storing, and preparing the crop for feeding and for marketing; and methods of marketing should be understood.

Problems for Study and Discussion.—(1) How do kafir and other grain sorghums compare with corn in feeding value?

2. Describe different methods practised in preparing the crop for feeding. Compare these.
3. For what livestock is the crop sometimes ground?
4. What are the common practices in storing grain sorghum in your community?
5. How do moisture conditions affect the keeping quality of grain sorghums?
6. How may losses from rodents and other pests be controlled?
7. Ask the best growers as to the advisability of building ventilated bins for storing heads.
8. How does a large percentage of split or damaged kernels affect storage?
9. How much more space does head grain sorghum require than the threshed?
10. At what time of the year is the price usually highest?
11. If sold, in what form is this crop marketed?
12. Get opinions of farmers regarding coöperative selling of sorghum, grain, and syrup.
13. How do prices of corn affect prices of sorghum grain?
14. Discuss selling grain for seed. (Figs. 116 and 117.)

Activities.—Make a graph showing the trend of prices over a period of years.

Feeding Forage.—Sorghums are abundantly used for dry forage, for silage, and for soiling. Sweet sorghums are preferred for these purposes. Sugar in the stems causes the stems to be eaten along with the leaves. Sweet sorghum is often mixed with corn for filling silos.

Pasturing sorghum and growing small areas to be fed green as a soiling crop are often practised. Extreme care should be observed to avoid bloating and prussic-acid poisoning of cattle. This danger seems to be

greatest when the plants are in an immature stage and their growth and development has been suddenly arrested by drouth or by frost. Poisoning danger disappears as the crop reaches maturity, though it is a severe handicap in realizing the greatest value from the growing crop as there is no known preventative that is absolutely reliable.

FIG. 116.—Raymond Neeley has contracted this field of kafir to the Oklahoma Improved Seed Company at 10 cents per bushel above grain price.

FIG. 117.—Student tagging the early-maturing kafir heads in his contracted seed field.

Feeding Grain Sorghums.—These grains are fed to all classes of livestock in regions where they are grown. They require a little more protein feed in balancing the ration than does corn. In feeding value they are about 90 per cent as rich as corn. Their popularity as poultry feed is gaining steadily. Corn rations for livestock may be followed in feeding grain sorghums with adjustments for their differences.

Broom-Corn.—The straw of broom-corn may be rated for market purposes on the following points: color of straw (clear green), 25; freedom

from seed, 10; freedom from moisture, 10; well baled, 25; straw dried straight, not curled, 20; length of brush, 10.

Selling Syrup.—The product sells best when it is of uniform consistency, clear, pure, and of good flavor. One evaporated lot should not be made more dense than another. Syrup making is an art which requires great skill. This product is usually sold in tin cans of sizes to suit family use. Proper labels on the cans will add greatly in selling and the owner is rewarded with better prices. The labels should be placed on the cans at delivery time. The price is usually much higher later in the winter and spring than at harvesting time. The cost of holding is very slight.

FIG. 118.—Common method of storing kafir to await threshing. This 5-acre Oklahoma project yielded 110 bushels.

Storage of Grain.—Fodder may stand in shacks until well cured. To save the grain longer, heads are cut off and stored in ventilated cribs lined with fine wire netting to keep out mice and birds. If attacked by weevils or moths, it should be treated in a tight bin with carbon bisulfide (see job 6). The grain may be threshed before treating to save room. It is best to thresh and clean all grain intended for market as soon as it is well cured (Fig. 118). Grain threshers and fanning mills are used.

The loose grain is stored in bins as in the case of wheat. It is more liable to mold and should be moved and aired every three weeks or less as the season advances.

Sweet Sorghum Seed as Feed.—Several carefully conducted experiments have indicated that the value of sorgo seed as feed is only slightly less than that of the grain sorghums or of corn. It is less palatable

to livestock because of the tannin content and the slightly astringent effect. This is sometimes thought to reduce the production of milk in dairy cows, but the claim has not been substantiated by experiment.

Job 13. Keeping Records

(See corn enterprise)

References to State Bulletins and Circulars.—Neb. 206; Kan. 218, 225, Circ. 110, 119; Colo. 124; New M. 119, Circ. 44, 84; Okla. 102, 127, 150, 155, 215; Tex. 236, 294, 359.

Things to Make at Home.—Boxes or crates for shipping gallon cans of sorghum; stripping frame for stripping heads by hand.

MILLET ENTERPRISES

Millets are closely related to sorghum. A number of plants of the grass family belong to this group. They produce crops quickly when grown in the warm part of the summer. They are all shallow rooted and are ravenous feeders.

Types and Varieties.—The foxtail millets are most popular, the principal varieties being Common, Hungarian, and German. While Common millet is the most popular of these because of its earliness, it is not so productive as Hungarian, which has larger heads and is very productive of seed and hay. German millet does not tiller so freely as the other two. The heads are nodding and the crop suffers a little more from lodging in high winds.

Broom-corn millet is grown more for seed than for hay, the latter being very coarse and rather unpalatable.

Barnyard millet is a rank weed seldom sown except when unduly advertised by seedsmen. It produces large yields of coarse, fibrous forage and becomes unpalatable. It should seldom, if ever, be used in preference to foxtail millets.

Pearl millet has stiff, erect heads one-half to one foot in length. The seeds are a little smaller than kafir. Its suckers produce second or third growth after cutting. The fodder is much coarser than that of foxtail millets.

Soils and Their Preparation.—As in the case of sorghums, millets respond well to plenty of soil fertility. Rich loams give best crops. The millets do not endure dry climates so well as the grain sorghums, but they can use the moisture in the soil to better advantage than many other crops. Plenty of moisture increases yields very much.

Millets will grow only in warm summer months and require only a short season. As commonly practised, millets are too frequently grown

on soil where other hay crops would fail. Millets succeed in all states from Canada to the South.

The soil should be well prepared before seeding as the seeds are small. It should be well harrowed perhaps several times before sowing. The bare fallow plan suits this crop well. The crop is, however, a good fighter of weeds; in fact it is often grown on weedy fields to help smother them out.

Seeding.—The foxtail varieties are seeded at the rate of about one to two pecks per acre by broadcasting methods. Harrowing should follow to cover the seeds slightly. Heavy seeding makes finer hay.

Millets and cowpeas or soybeans are often sown together for hay. Use one bushel of cowpea or soybean seed with one peck of millet per acre.

Harvesting.—When hay is the main purpose the heads should not be allowed to ripen. Cutting may begin soon after the formation of heads. When mixed with soybeans or cowpeas the crop should be cut before the millet seeds are ripe, and at that stage the mixture is not difficult to cure.

Harvesting for seed should begin as soon as the seed begins to harden. The crop may be cut with a binder or with a mower. The seed does not shell badly, and raking wastes very little of it.

Threshing is done with an ordinary grain thresher and may take place as soon as the cut crop has passed through a sweat in shocks. Yields of seed vary from 15 to 25 bushels per acre. The seed is sold in market and used as bird seed, as a part of poultry feed mixtures, and for resale through seed companies. (See U. S. Farmers' Bulletins: 793, Foxtail Millet; 1162, Hog Millet.)

GRASS ENTERPRISES

By Z. M. Smith, A.B., A.M., B.S.A.

Professor Agricultural Education, Purdue University, Indiana. State Director Vocational Education

Analysis into Jobs.—The true grasses used for hay and pasture are included in this treatment. The growing, curing, using for hay and pasture, the production of seed, and marketing are all considered. The grasses included are timothy, orchard grass, redtop, brome grass, fescue, bluegrass, Bermuda, sudan, and rye grass. References are made to U. S. Farmers' Bulletins. See also *Forage Crops* by Piper and text-books on grasses by Close and Hitchcock.

1. Determining possibilities with a grass crop.
2. Choosing the crop or the mixture. 1254, 1433, 1476.
3. Deciding on soil, field, and acreage.
4. Securing good seed; cleaning; testing.
5. Buying and mixing fertilizers.
6. Preparing the field for sowing.
7. Liming the field. 921.
8. Sowing and fertilizing.
9. Caring for crop and cultivating. 1254, 1433.
10. Controlling enemies.
11. Harvesting and curing hay.
12. Harvesting seed and threshing.
13. Using pastures. 1476.
14. Feeding hay crops.
15. Baling hay and marketing hay.

Job 1. Determining Possibilities with a Grass Crop

Conditions Usually Found.—(1) Most farmers grow grasses for pasture or for hay if they keep livestock. (2) The grass crops are profitable when adapted to soil conditions and judiciously managed. (3) Too often the relation of the crop to soil fertility is not given due consideration.

Aim.—(1) Students should consider the place of grass crops in their farm-business plans. (2) They should study the problem from the viewpoint of both the present and the probable future situation.

Problems for Study and Discussion.—(1) Seek the advice of men who have had experience with the grasses. Confer personally with men in your neighborhood and read from books written by recognized authorities on the subject.

2. Which of these grasses have proved to be most profitable in your region; for hay; for pasture?
3. What uses have been made of these grasses by farmers who have grown them with profit?
4. What effects have these crops had on the soils in your region?

5. How many of the farmers turn under a grass sod each year as green manure?
6. To what degree is each of the grasses grown locally adaptable to the rotation in which it has been used?
7. What has been the annual yield of each in hay?
8. For how many successive years can the best be grown profitably?
9. Are the soils of your region in condition for the profitable growth of these grasses?
10. If your soils need treatment in order to justify either introducing these crops or continuing their production, what treatment is required?

Grass a Valuable Feed for Livestock.—Grasses are of fundamental improtance in maintaining livestock. They are used for both hay and pasture. Some of them are suitable primarily for hay, and some primarily for pasture. They are palatable and nutritious and are relished by all kinds of livestock (Fig. 119). When these crops are grown and used under

Fig. 119.—These fat shorthorns evidently do not wish to leave this luscious blue grass pasture. Good pasture is essential in beef projects. (J. C. Allen.)

wise management, they are of material importance in keeping the cost of livestock production down to a minimum.

Grasses Used for Soil-Improvement.—If properly managed, grasses are valuable for soil-improvement purposes. They may be so utilized as to add needed vegetable matter and thus improve the mechanical condition of the soil. The presence of humus makes the soil friable, improves its capacity for controlling moisture, promotes aëration, and releases fertility for other crops.

If grass is grown solely as a money crop, there is a strong likelihood that it will be managed so that the fertility of the soil will be decreased. Unless the elements removed from the soil by the grass crops are returned by applications of manure and fertilizer, the result will be depletion of soil

fertility. It has been demonstrated through reliable experiments that the use of manure and fertilizer with grass crops is a profitable practice.

Grasses in Crop Rotation.—The place of grasses in crop rotation depends in part on topography. If the land is too broken and rough for cultivation, such areas may be utilized for permanent pastures. In some cases it is advisable to keep hillsides or steeply sloped areas covered with grass to prevent erosion of the soil and to utilize profitably such areas as are ill adapted to grain crops because of their susceptibility to erosion.

Where extensive farming is practised, certain areas adapted to grass production can be kept in pasture permanently if given proper treatment.

In the corn belt states and in areas similar to them in topography and climate, the grasses may well be given a regular place in the system of crop rotation. When grass is used in rotation either as a hay or a pasture crop, every precaution should be taken to prevent depletion of soil fertility. The same practices that serve to maintain the fertility of the soil will likewise bring increased production.

Grass as a Money Crop.—There are conditions that justify the production of grass as a money crop. The crop may be grown for hay or seed or for both purposes. If the soil is peculiarly suited to the production of hay and seed, these crops may be grown profitably for the market, provided a system of management is followed to prevent depletion of soil fertility.

Job 2. Choosing the Crop or Mixture

Conditions Usually Found.—(1) The farmer's knowledge of grasses is often limited to the varieties grown in his neighborhood. (2) In many instances the farmer's wise choice of grasses is restricted by reason of his limited knowledge of the different varieties. (3) Timothy is used primarily for hay. (4) Orchard grass is grown for both pasture and hay. (5) Special advantages of certain grasses are often well understood by growers.

Aims.—(1) Students should study the different grasses in order to determine which are best suited to their farm management plans. (2) They must know what uses to make of these grasses to realize a maximum profit from them.

Problems for Study and Discussion.—(1) Which of these grasses are grown in your region?

2. Which varieties would be best for hay in your region? Which most productive?
3. Which would be most profitable as a source of organic matter for the soil? Why?
4. Which of these can be used to best advantage for pasture? Why?
5. Determine which is best suited to your plans for crop rotation?
6. Find the cost of seed per acre for each of these grasses.
7. Determine the relative feeding values of these grasses when used as hay.
8. Locate on a map of the United States the present distribution of each of these grasses.
9. What mixtures of grasses or of grasses and legumes are well suited to your region?

Choice Dependent on Use.—The use to be made of a grass crop is of prime importance in deciding which variety or what mixture to sow.

If the crop is to be used for hay, the selection of the variety or the mixture should depend upon whether the hay will be sold on the market or fed to livestock locally. Usually a better price will be paid for market hay if it is made of one grass rather than a mixture of grasses. On the other hand, if the hay is to be grown wholly for home use a mixture may be desirable on account of both the greater variety of herbage and the greater production thus to be obtained.

If pasture is the objective, the choice of grasses will be determined partly on the basis of whether the pasture is intended to be permanent or temporary.

Adaptation to Soil.—It is not profitable to try to grow grass on a soil to which it is not adapted. For the profitable production of grasses, the grower must understand the soil requirements of the different varieties. He must know which variety is best suited to the lowlands, for example, and which to the marshes, the wet areas, the dry areas, the uplands, the sandy lands, or the woodlands.

Climatic Conditions.—It is useless to try to grow a given variety of grass in a climate that is not congenial to it. Timothy, for example, requires a temperate and moist climate; it would not be expected to thrive in a torrid, or frigid, or dry climate.

Timothy is the most important hay grass in the United States. The extensive use of this grass for hay is due to several things, important among which are its palatability, nutritive value, wide range of adaptation throughout the temperate region, and the facility with which it can be harvested and marketed.

Orchard Grass.—Hay made from this grass is said to possess feeding value equal to that of timothy, but it is not a successful rival of timothy in the area known as the timothy region. South of this region, orchard grass occupies a position of importance as both a hay and a grass crop. It thrives in shaded areas such as orchards, from which fact it derives its name.

Redtop ranks high as a pasture crop but is not the equal of bluegrass. It possesses high feeding value as hay but is not as palatable as timothy. It is grown more extensively for pasture than for hay. Redtop will grow in practically every state, but it is not of equal importance in all states.

Brome Grass.—This is primarily a pasture grass. It will furnish pasture from early in the spring until late in the fall. In this respect it is unequaled by any other variety, unless it be orchard grass. Although it will grow in every state in the Union, it is best adapted to the northern portion. It almost equals timothy in feeding value as a hay.

Fescue.—The usual practice with fescue in the United States is to use it in mixtures, unless it is to be grown for seed. As a seed crop it has attained importance in Kansas and Missouri. It is valuable for hay and for pasture, especially when used in mixtures.

Blue-Grass.—This crop is preëminently the pasture grass in the corn belt of the United States and in the region immediately south of this area. It is palatable and nutritious and is relished by livestock. If kept supplied with sufficient moisture, this grass will supply pasture from early spring until late fall (Fig. 120). As a rule, however, the summer months are too dry and hot for the maintenance of blue-grass pasture. Moderate rainfall at frequent intervals is highly favorable for this crop.

FIG. 120.—Lambs on blue-grass pasture make a fine combination for fat sheep and good mutton. (J. C. Allen.)

Blue-grass is not a satisfactory hay crop. When made into hay it becomes dry and unpalatable and is not relished by livestock.

This grass is used extensively for lawns throughout the blue-grass section of the United States. Its dense, thick growth produces a firm but velvety turf which, if kept supplied with water, remains green the greater part of the year.

Bermuda Grass is acknowledged to be the most important grass in the South. It is used principally for pasture but it is an important hay crop also. It compares very favorably with timothy in regard to its feeding value.

It is relished by all kinds of livestock. No other southern grass excels it in succulence and palatability when it is kept closely grazed. Nor is it excelled in the amount of grazing it will furnish.

Bermuda grass is eminently suited for preventing soil erosion because its matted roots will bind and hold together the most friable of soils.

Sudan grass has been found to be satisfactory as an emergency hay crop or for a pasture crop in the corn belt. As a catch crop and a summer pasture, it has proven itself valuable. Its feeding value is said to equal that of oats, hay, millet, or timothy. Sudan hay is relished by sheep, horses, and cattle. It is strongly resistant to drouth and hot summer weather.

It thrives best in a warm climate and is considered superior to millet as an emergency hay and pasture crop. It is a heavy yielder under favorable conditions, sometimes producing two or three cuttings in a season, though it must be cut before it matures to prevent it from becoming too stemmy, and even then, it lacks the good quality and feeding value of other grass hays.

Its chief value lies in its adaptability to a variety of soil and climatic conditions and to a short growing season. It can be used as a catch or cover crop after other crops and there is less danger, than with true sorghums, of prussic-acid poisoning in pasturing it or using it as a soiling crop. It may be drilled or sown broadcast but is usually handled as other hays.

It pollinates freely with other members of the sorghum family and thus deteriorates rapidly when planted near the other groups and types. Furthermore, because of the similarity, Johnson grass is a dangerous adulterant south of latitude 38. (See U. S. Farmers' Bulletins, 1126, 1254; Okla. Bul. 103, 115; Kan. 212.)

Rye Grass.—There are three kinds of rye grass that have sufficient importance to entitle them to consideration, Perennial, Italian, and Western. Of the three, Western rye grass is of greatest importance in America. It is especially adapted to the prairies of the northwestern states and of northwestern Canada.

Rye grass is grown for both hay and pasture. The grazing period for this grass is of short duration. Its growth starts late in the spring and declines in vigor in the autumn. The hay is satisfactory, if harvested early.

Job 3. Deciding on Soil, Field, and Acreage

Conditions Usually Found.—(1) In many cases farmers do not give due consideration to the suitability of the soil for growing a given grass crop. (2) The place of the crop in the rotation is often the main factor in selecting the field. (3) The acreage is usually determined on the basis of the field chosen, rather than on the basis of business management plans.

Aims.—(1) Students and growers should know the soil and other conditions most conducive to the profitable growing of grasses. (2) They should learn to plan rotations which include the use of grasses to good advantage.

Problems for Study and Discussion.—(1) What improvement do your soils need to make them suitable for the production of grasses?

2. Would it be profitable to increase the acreage of grasses in your region?
3. Should the acreage of grasses on your farm be increased?
4. What soils of your region are best adapted to the hay grasses?

5. Which soils are best for pastures?
6. Compare heavy and light soils for grass growing.
7. Compare uplands with lowlands for grass growing.
8. On your farm or a neighboring farm choose a field where grass should be seeded. Give your reasons.
9. Inquire locally regarding the best rotations including hay grasses.
10. What plans are made for using hay fields a part of the year for pasturage?
11. Plan a good rotation for growing grasses on your own or a neighboring farm.

Deciding on Soil.—Selection of the type of soil to be planted to grass should be governed in part by the kind of grass desired. If timothy is to be sown, the soil should be moist and fertile and should be supplied, moderately at least, with vegetable matter. This grass will grow on a wide range of soils but will thrive best on rich loam adequately supplied with moisture.

Clay loam soil and sandy loam with a rather close clay subsoil are the types best adapted to the production of orchard grass.

Redtop has a fairly wide range of adaptability, but like other grasses must be grown in its most favored soil if best results are to be obtained. Unlike the majority of grasses, it will grow in acid-reacting soils and in soils that are wet and undrained. It can be grown successfully in heavy clays.

Brome grass thrives best in moist loams, but will grow fairly well on other types that are not too coarse in structure. Because of its deep-rooting qualities it may be grown profitably in semi-arid regions.

Fescue is a deep-rooted plant which, having become established, will maintain its hold on fairly dry soils for several weeks of drouth. Clay loam soil is the type most congenial to this plant.

Blue-grass thrives best on the clay or clay loam soils of Kentucky, Tennessee and Virginia. It will not grow satisfactorily in acid soils nor in loose, sandy soils. It does well as a pasture grass on the limestone soils of the corn belt region.

Bermuda grass is at its best in sandy soils rich with alluvial deposits. It can, however, be grown successfully on soils low in fertility and on soils with a relatively high percentage of alkali.

Sudan grass will thrive on soils suited to growing corn. The soil should be warm when the seed is sown. If it is seeded on cold soil, germination is retarded and the growth of the plant is slow.

Rye grass is well suited to sandy clay loams, such as are found in prairie regions of the West and Northwest.

Rotation a Factor in Choice of Grass Crop.—The system of crop rotation found by experience to be profitable management occupies an important place with reference to deciding which grass to grow. (Job 2.)

Some of the questions that should be raised concerning each of the

grasses follow: Must the soil have been clean cultivated? Is this grass suitable to precede or to follow a small-grain crop, a forage crop, a tuber crop? Is it adaptable to seeding on fallow soil? For which is it best suited—a short rotation period, or a long rotation period?

The Field and the Acreage.—A haphazard choice of field and acreage for a grass crop is not to be recommended. In fact, such procedure should be condemned. Where to seed the grass and how many acres to sow should be determined on the basis of an approved farm-management plan. The number and kind of livestock; the length of the rotation period; need for temporary or permanent pasture, a money crop, or a soil-improvement measure; and similar items; must be considered in formulating this plan of farm-business management.

Job 4. Securing Good Seed; Cleaning; Testing

Conditions Usually Found.—(1) Farmers often make the mistake of buying uncertified and untested seed. By reason of such practice obnoxious weeds have been introduced on their farms and poor stands have been secured from seed of low vitality. (2) State and federal laws have been enacted to prohibit the sale of undesirable seed. (3) Often home-grown seed is not properly cleaned and tested.

Aims.—(1) The importance of using only high quality seed should be understood by students. (2) They should know how to secure good seed. (3) They should form the habit of cleaning and testing seed for sowing.

Problems for Study and Discussion.—(1) What methods do farmers in your community follow in securing their grass seed?

2. Which method do you consider the best? Why?
3. Which method do you consider the least satisfactory? Why?
4. What assistance in procuring high-grade grass seed can farmers receive from their state agricultural experiment station?
5. Give a concise but clear description of the most highly approved method of examining seeds for impurities.
6. What method of cleaning seed is most satisfactory in your region? Describe this method.
7. What legal provision has your State made to protect farmers against impurities in grass seed?
8. Why should farmers test grass seed before sowing it?
9. Why should grass seed be cleaned?
10. Describe the cleaning of grass seed with a fanning mill.
11. What states produce good-quality grass seed for the market?

Activities.—Practice cleaning and testing seed.

Securing Seed.—A grass crop that is to be harvested for seed should not be foul with weeds. Weed-infested fields should be freed of the weeds before the grass seed matures. After every precaution has been taken to clean a field, it is possible that some obnoxious weeds may be left. The seeds from these weeds may become mixed with the grass in harvesting and threshing. Grass should be harvested for seed as soon as ripe and before it becomes so dry that the seeds will shatter. Seed of strong vitality and of high germination quality cannot be secured from immature plants.

If seed is to be purchased locally, it is advisable that the seed-fields be inspected before harvest time by the state agricultural experiment station or other equally competent and reliable authority. Unless the inspected fields can be certified as meeting the minimum standard set up by the inspecting agency with regard to freedom from noxious weeds, immature seeds, mixture of varieties, and like impurities, the seed from those fields should not be purchased for seeding purposes.

If seed is to be secured on the market, only that which has been certified by the legally constituted inspecting authority for the State should be purchased.

Cleaning Seed.—Although every known precaution may be taken to eliminate weeds from the grass before harvesting and in the threshing process, the grass seed are usually more or less contaminated with weed seeds. Other impurities such as chaff, particles of vegetation, and immature seeds will be found.

Grass seed should be cleaned before it is put on the market. If impure seed is purchased, the buyer pays grass-seed prices for weed seed, chaff and like objectionable foreign matter. Home-grown seed should be fanned carefully before it is seeded. It is bad practice to sow impure seed. Unless pure seed is used, the fields will become infested with foul weeds.

Testing Seed.—Grass seed should be tested for purity. An accurately weighed sample of seed or a lot of one hundred seeds should be separated carefully into pure seed, weed seed and other foreign matter. The division having been made, the percentage of impurities can be determined by weight or count.

Grass seed should be tested for germination. It is poor economy to sow seed of low vitality. Profitable yields cannot be obtained from such seed. To sow dead seed means a total loss of time, money invested, labor, use of land, and desired crop. Only viable seed should be sown.

The temperature required for the germination of grass seeds varies with the kinds of grasses. The time required for germinating grass seed is not the same for each grass. Alfalfa will germinate in 6 days at a temperature of 70 degrees F., while blue-grass requires 28 days at a temperature of from 70 to 85 degrees F. The other grasses come within these extremes.

Job 5. Buying and Mixing Fertilizers

Conditions Usually Found.—(1) The principles underlying fertilization of the soil for grass production are not understood as well as they should be by many farmers. (2) Farmers in general are not so familiar as they should be with the best known methods of mixing fertilizers. (3) Too often farmers buy a brand of fertilizer because it is commonly used, whereas they should buy fertilizer on the basis of the demonstrated needs of soil and crop.

Aims.—(1) Growers should learn how to determine the kind of fertilizer their

soils need for the production of grasses. (2) They should become skilful in mixing fertilizers. (3) They should adopt the most highly approved method of purchasing fertilizers.

Problems for Study and Discussion.—(1) Do farmers in your region mix their fertilizers or do they purchase them commercially mixed? Ask them why.

2. How do farmers of your region determine what kind of fertilizers to use on fields seeded to grass?
3. To what extent do farmers buy fertilizers coöperatively?
4. Determine the kind of fertilizer your soil needs for profitable grass production.
5. What are various factors that must be considered in determining how to purchase fertilizers economically?
6. From dependable data determine whether it is more economical for you to purchase your fertilizer mixed than to purchase the ingredients separately and mix them yourself.
7. What have farmers of your region found to be the plant food deficiencies of the soils they have seeded to grass—both before and after growing the crop?

Activities.—Practice mixing fertilizers.—Time for operation. Calculate costs.

Buying Fertilizers.—The plant-food requirements of the crop to be grown and the amounts of these elements in the soil and available to the growing crop are of fundamental importance in determining the kind and amount of commercial fertilizer to use. The purchase of fertilizers without knowing what is needed to supply the plant foods in which the soil is deficient is not only ill-advised practice but is uneconomical in the extreme.

When the kind and amount of fertilizer needed have been determined, the source of the available supply should be learned. The local dealer may have a supply on hand or he may be able to fill the order through shipment within a period of a few days.

It may be economical to purchase direct from the wholesale market. When this practice is followed, the different buyers usually pool their orders and secure shipments in car-load lots. This is one method of co-operative buying. The several orders are placed with a secretary who acts as agent of the purchasers. He pools these orders and has the total amount delivered as one shipment. This method of buying fertilizers has proven satisfactory in many instances.

Motor-truck transportation over paved roads makes it possible in many cases for the individual purchaser to obtain his fertilizer direct from the manufacturer.

Too often the farmer fails to purchase fertilizers, because he thinks he cannot afford the expense. As a matter of fact the successful growing of a grass crop may hinge, in a given case, on the use of fertilizers. In such case, the farmer cannot afford to omit the application of fertilizer to the soil to be seeded.

The supply of available barnyard manure and decomposed vegetable matter for spreading on the field to be seeded to grass will materially influence the making of an approved program for applications of commercial fertilizers.

Mixing Fertilizers.—Fertilizers may be purchased mixed ready for use or the materials needed to meet the conditions of the situation may be secured separately and mixed by the purchaser. If the farmer can buy the fertilizers having the proper analyses that fulfil his requirements, it may be his most economical method of obtaining his fertilizers. The material used as carrier and the price of the commercial mixture are important in determining whether it is advisable to purchase fertilizer commercially mixed. (See Appendix for plant food removed. See corn enterprise for method of mixing).

Job 6. Preparing the Field for Sowing

Conditions Usually Found.—(1) When grasses are sown with cover crops, the preparation of the soil for the cover crop is usually the best preparation for grass seed. (2) The type of soil, the time of year, and climatic conditions are important factors to be considered in determining the kind of seed-bed preparation needed. (3) In many cases the cause of a poor stand of grass is inadequate preparation of the seed bed.

Aims.—(1) Farmers should learn the importance of a good seed bed for successful production of grass. (2) They should learn to practise the best known methods of seed-bed preparation.

Problems for Study and Discussion.—(1) Compare the preparation of soil with the time of year in which grass is sown.

2. What is the method of seed bed preparation used by most of the farmers of your region?
3. Compare the effectiveness of the different kinds of implements and machinery used in the preparation of a firm seed bed.
4. What proportion of farmers of your region start grass crops without a nurse crop?
5. When grasses are started with nurse crops, what kinds of crops are used?
6. What is meant by a firm seed bed? By a loose seed bed?
7. What factors would you consider in determining which kind of seedbed to use?
8. What is considered good practice in seed-bed preparation with loam soils? With clay soils?
9. Briefly explain in what ways the seasons are of importance in determining the kind of seed bed to prepare for grasses.

The Seed Bed.—The seed bed for grass seed should be firm and finely pulverized. This condition of the soil is necessary because the seeds are small. They will not germinate and take root satisfactorily unless they are thoroughly embedded in the soil. It is from the soil particles in contact with them that the seeds get the moisture, warmth, and plant food necessary for their germination and their development into plants.

The seed bed needs to be finely pulverized in order to conserve moisture for the growing plants, and to provide a favorable medium for transmitting of plant foods to these plants.

If the climate is dry, it pays in most cases to have a considerable interval between the plowing of the field and the seeding of the grass.

The degree of fineness desirable for seed germination and plant growth depends in large measure on the type of soil. In general, the more friable and the lighter the soil the finer it may be pulverized advantageously to the grass plants. If the soil is heavy and the season is rainy, the soil may easily be made so fine that the impaction of the soil will prove injurious to seed germination and to plant growth.

The fineness of the soil to be desired depends to some extent upon the time of year. As a rule the soil should not be as fine for fall seeding as for spring seeding.

When grass seed is sown with a cover crop, the kind of seed bed that is best for the cover crop is usually the most suitable for the grass seed.

Quite frequently grass seed is sown in the spring on top of the ground where there is a growing crop of small grain, such as wheat, oats, rye, or barley. Certain of the grasses may be seeded with a nurse crop in the autumn.

The seed bed for grasses should be clean. If it is not clean, the seed cannot become thoroughly imbedded in the soil. This condition will hinder germination and will interfere with the plant rootlets becoming attached to the soil.

If the ground is to be plowed, the plowing should be relatively shallow. Usually a depth of three or four inches is sufficient.

Pulverizing Implements.—The kind of implement best suited for soil pulverization depends upon the type of soil and its condition. The disk, the spring-tooth harrow, the spike-tooth harrow, the drag and the cultipacker or other rough roller are the most commonly used means of fining soils. The stiff and heavy soils may require a thorough disking, rolling or dragging and harrowing. Mellow soils may need nothing more than a thorough harrowing. Soils that have clodded badly as a rule yield to treatment with the roller, disk, drag, and harrow.

The aim in the use of any kind of implement is to produce a seed bed pulverized to the degree of fineness best suited to the needs of the grass crop to be grown.

Job 7. Liming the Field

Conditions Usually Found.—(1) In most of the regions where the grasses are sown the soil is not limed. (2) In some parts of the humid region liming for grasses has proved to be very profitable; it is not as commonly practised as it should be.

Aims.—(1) Conditions requiring the liming of soil and the benefits of liming should be understood by students. (2) They should learn how to buy economically the right forms of lime and how to use it properly on their fields.

Problems for Study and Discussion.—(1) By inquiry determine how many. if any, farmers of your neighborhood use lime for growing the grass crops either before or after sowing.

2. What farmers find it profitable to use lime on their grass crops either when mixed with clover or when grown alone?

3. What would you recommend, after talking with local farmers, regarding the use of lime on meadows and pastures?
4. What forms of lime are most economical for purchase in your region?
5. How can farmers coöperate in providing their own lime in limestone regions?
6. Describe a good lime kiln.
7. Describe the work of a lime crusher.
8. What rates of application of lime are considered light? Heavy?
9. Compare burned, crushed, and hydrated lime in activity and strength.
10. Which of these would you use most frequently? How often would you use each form?
11. Why should lime be applied on top of the plowed ground rather than plowed under?

Activities.—Collect samples of different forms of lime. Obtain lowest prices of each kind.

Need of Lime.—Most of the grasses will not thrive on acid soils. Redtop is one important grass that will grow in acid-reacting soils. For timothy, blue-grass, fescue, Bermuda grass and others, the soil must be sweet.

Lime is the neutralizing agent commonly used to correct soil acidity. Too often lime is not used, even though needed badly. If the grass is seeded with a nurse crop, the land should be limed at the time the seed bed is prepared for the nurse crop.

Kinds of Lime.—The farmer should use the kind and amount of lime recommended by his state agricultural experiment station. The individual farmer cannot afford the cost of experimentation when he has available for his guidance the findings and recommendations of his station. The lime selected for use should be finely divided and should be thoroughly mixed with the soil. Fresh-burned lime, water-slacked lime, air-slacked lime, chalk, marl, or finely crushed limestone are the kinds most commonly recommended.

Amount of Lime to Use.—The amount of limestone to use varies. As a rule the application can profitably be as heavy as two tons per acre. However, there are cases for which one ton per acre is sufficient, whereas there are other cases for which ten tons per acre may be required.

When and How to Apply Lime.—The limestone may be applied as a top dressing on the growing crop. This practice is necessary in cases of meadows or of permanent pastures where the soils need lime. If the grass is seeded openly by itself, the lime may be spread over the soil before the seeding is done. The application should be made after the seed bed has been prepared. The material should be spread evenly. To economize on time and labor and to insure evenness of distribution, a lime spreader should be used. After the limestone has been spread it should be harrowed into the soil.

The limestone should be well distributed in the first three or four inches of the soil because it is at this depth that certain beneficial soil bacteria do a great deal of their work.

Procuring the Limestone.—The need of lime should be determined well in advance of the time it is to be applied so that satisfactory arrangements can be made for procuring it. The shipping distance and the hauling distance from the freight terminal are two important factors that enter into the cost of limestone. The lime should be shipped from the nearest manufacturer, provided the grade and price are satisfactory. The shipping point should be at the shortest distance possible from the farm or farms on which the lime is to be used.

In many instances farmers have found it profitable to buy their limestone coöperatively. It has been found advisable in some cases to provide storage space at the shipping point in order that there may be no difficulty in having the limestone at hand when the farmers are ready to haul it home.

Job 8. Sowing and Fertilizing

Conditions Usually Found.—(1) The methods of sowing vary widely in different regions and with different grasses. (2) The rates of sowing and time of sowing also vary.

Aims.—(1) Students should learn the best time and most economical methods of sowing grasses locally. (2) They should know the rates of seeding for the different grasses, different soils, nurse crops, and mixtures.

Problems for Study and Discussion.—(1) Talk with local farmers and find their different methods of starting grasses.

2. Find what methods of sowing are used. Describe each of these.
3. How many pounds per acre of seed are used for each of the grasses grown locally?
4. Try to explain why these rates differ.
5. Give a good rule for the rate of seeding on poor or light soils.
6. Give the rate where conditions are most favorable for growth.
7. Give methods of covering grass seed after sowing.
8. Compare good and bad methods of sowing and of covering grass seed.
9. Where fertilizer is to be used at seeding time describe good methods to use.
10. Under what conditions would you roll the soil after sowing grass seed?
11. Why is a cultipacker or other rough-surface roller better than a smooth roller for this purpose?

Activities.—Practise using drill attachments and seeding machines.

Time to Sow Grasses.—The time of sowing grass seed depends in large measure upon the variety of grass and the climatic conditions. For example, timothy may be sown either early in the fall or early in the spring. Orchard grass may be sown at different seasons. Probably more seeding of this grass is done in early spring than at any other season. It has been sown with success late in the summer or early in the fall. Redtop is commonly sown in the spring in northern regions and in the autumn in southern regions. Brome grass may be seeded at any time during the growing season under favorable conditions. As a rule, the

best time to sow this grass is early spring. Meadow fescue is commonly sown in the autumn in the South and in the early spring in northern regions. Blue-grass is usually sown in the autumn in the region where it is at its best. It may be seeded advantageously in the autumn in northern areas, but the more common practice in these areas is to sow it in the spring. Bermuda grass may be planted at any time from early in the spring until early in the summer, but it is advisable to plant early rather than later in the growing season. Sudan grass should be seeded about two weeks after corn-planting time. Rye grass is more likely to grow with success if it is sown late in the spring or early in the summer than if sown earlier or later.

Methods of Sowing.—Timothy seed may be scattered in the spring and left lying on top of honeycombing soils that are carrying a winter grain crop. The alternate thawing and freezing of the soil serves to imbed the seed sufficiently to induce germination and growth. If sown in the spring on soils that do not honeycomb, the seed should be harrowed into the soil.

When timothy is sown in the autumn, either alone or with a nurse crop, the seed should be covered.

Timothy may be sown with a drill, with a hand seeder, or with a broadcasting machine, when seeded alone or when seeded with a nurse crop at the time the nurse crop is sown. The hand seeder or the broadcasting machine method requires follow-up with a harrow to cover the seed.

When seeded in the spring on a winter crop that is carried by soils that honeycomb, the hand seeder or broadcasting machine is commonly used.

The hand method is more commonly used than any other for seeding orchard grass, redtop, brome grass, meadow fescue and blue-grass, when sown alone.

Rye grass may be seeded by hand or with a hand seeder, or it may be drilled.

Bermuda grass is commonly propagated by planting portions of the roots or small cuttings of sod. These are usually planted in shallow furrows at intervals of one or two feet.

Sudan grass may be seeded by broadcasting and harrowing. Experience indicates strongly that finer stems will be produced by broadcasting than by drilling the seed.

Rate of Seeding.—The rate of seeding grasses varies with the soil and the use to be made of the crop. Seeding alone and using in mixtures are of importance in determining the amount to sow per acre.

RATES OF SEEDING GRASSES—POUNDS PER ACRE

NAME OF GRASS	WHEN SOWN ALONE	IN MIXTURES
Timothy	8 to 12	3 to 6
Orchard grass	14 to 28	12 to 14
Redtop	7 to 14	3 to 6
Brome	Hay 12 to 15 Pasture 15 to 18	3 to 6
Meadow Fescue	28	5 to 14
Blue-grass	20 to 28	5 to 10
Rye Grass	15	7 to 8
Sudan Grass	10 to 15	8 to 10

Fertilizing Grasses.—Grasses will thrive in proportion to the supply of suitable plant food that is available for their use. Farmyard manure possesses the plant-food elements essential to the successful production of grasses. Many times barnyard manure is not available in sufficient quantity to supply the needs. In such case it is necessary to use commercial fertilizers.

Barnyard manure may be spread over the soil and plowed under or it may be applied as a top-dressing for the growing crop. Commercial fertilizer may be used to top-dress the growing crop and may be harrowed or drilled into the soil when the crop is seeded.

Job 9. Caring for Crop and Cultivating

Conditions Usually Found.—(1) Many meadows and pastures which indicate poor care are found in all regions. (2) Farmers often practise good methods of maintaining grass lands with profit for the extra labor involved.

Aims.—(1) Conditions requiring special care and management for grass lands should be understood by students. (2) They should learn the effect of each special treatment and how and when to practise it.

Problems for Study and Discussion.—(1) Make a study of the pastures and other grass lands of your region and report which ones you consider too thin, too weedy, or otherwise unprofitable.

2. Which farmers sometimes practise special treatments of their meadows and permanent pastures, such as extra mowing, harrowing, extra seeding, top-dressing with manure or commercial fertilizer or lime?
3. Describe the conditions under which mowing of pastures or extra mowing of old meadows would help.
4. Under what conditions would grass land be improved by harrowing and extra seeding?
5. Describe a field which might be improved by lime after the grass is beginning to deteriorate.
6. What are the dangers of top-dressing an old grass field with barnyard manure? Why would you use commercial fertilizer instead?
7. In what ways are grass lands sometimes mistreated regarding grazing?
8. Describe the different kinds of implements used for cultivating grass lands.

Cultural Methods.—Grasses for either pasture or hay should be sown on clean soil. The presence of weeds will interfere with the rooting and the growth of the grass plant. Furthermore, the weeds use up plant food needed by the grasses.

One indication of poor farming is the neglect of meadow or pasture. If the grass lands on a farm are not fertilized and cultivated, the unsatisfactory results are portrayed in less productive grain crops and in lower quality and less profitable livestock.

The meadow and pasture land may be kept free from weeds by cultivation with a disk harrow in the spring. The disk harrow should be followed with the spike-tooth harrow to smooth the surface soil.

Pastures should not be grazed too closely, nor should they be trampled by livestock when the ground is wet and soft.

Rotate Grass Lands.—Meadows as a rule are apt to become weedy in a few years. They should be used in rotations so that they will be plowed up at the end of the second year. There are, however, conditions under which land may be continued in meadow longer than two years.

Reseeding.—It may be advisable in some cases to reseed grass lands. The stand may be too thin to be profitable. If the soil is rich enough to carry a heavier crop, it will be profitable to add seed to increase the herbage. The plant can be allowed to mature sufficiently for the seed to shatter, or the seed can be applied direct by hand.

A top dressing of fertilizer may be required to make the grass crop profitable. If farmyard manure is used, it should be in such condition that it will disintegrate so that it can be spread thinly. If the barnyard manure is green and is applied too heavily, it will injure the grass by smothering it or by blistering it.

Mowing.—It may be advisable in some instances to clip the weeds on grass lands, because weeds take nourishment that the grasses need, and may also unduly shade the grass.

Sometimes it pays to mow the pasture or meadow and allow the straw to remain on the ground. By this means a mulch is provided and humus is added to the soil.

Effective cultivation for a grass crop can be and should be provided when the seed bed for the nurse crop is prepared. Clean cultivation and a finely pulverized soil properly fertilized provide conditions highly favorable to the growing of a profitable grass crop.

A grass crop is too valuable to be either abused or neglected. It is a crop that demands and deserves favorable treatment. If given the care it should have, a grass crop will yield abundant return for the attention given to it.

Job 10. Controlling Enemies

Conditions Usually Found.—(1) The general belief is that farmers seldom have difficulty from grass enemies. (2) In some regions serious insect attacks occur and bad diseases are found. (3) In some regions prairie dogs, gophers and similar enemies do much damage. (4) No doubt grass enemies do a great deal more injury than is generally realized.

Aims.—The different insects, diseases and animals which may injure their grass crops and the best methods of controlling them should be studied by students.

Problems for Study and Discussion.—(1) Inquire among farmers to see what enemies have ever affected local grass crops and how serious the losses were.

2. What remedies are followed in each case?
3. Describe the attacks of army worms in timothy and other grasses. Tell how they may be controlled.
4. Describe grass diseases which might attack meadows or pastures and give methods of control.
5. Describe the work of prairie dogs and tell what remedies have been suggested for their control.
6. Why are gophers considered injurious to grass lands?
7. In what way might flooding by high water injure a stand of grass?
8. What remedy would you suggest where this is apt to occur?
9. Examine small plots in different parts of your home meadow and estimate the decrease in yield due to grass enemies.
10. How is the control of grass enemies related to grain crops that follow the grass crop?

Activities.—Specimens of enemies should be collected and studied.

Grass Enemies.—The enemies of grass undoubtedly do more damage than is generally realized. This is true because of the fact that grasses supply so great an abundance of food for the insects that prey upon it that the consequent decrease in yield is usually unnoticed.

There are situations, however, which demand attention to prevent undue ravages from grass enemies. The white grubs may destroy a grass field by eating off the roots so completely that the only evidence of grass left is a thin layer of sod lying loosely on the ground. The army worms, the chinch bugs, or the grasshoppers may raid a grass field and clear it of foliage, leaving only the bare stems in part. Wire worms may do considerable damage by eating the roots of the grasses. The bill-bug larvæ attack the leaves of grass plants and many times do more damage than is realized.

Prairie dogs and gophers injure the grass fields by burrowing. They not only injure the plant roots but they may so thoroughly cover certain areas with their burrows as to render those areas unfit for either pasture or meadow.

One aspect of the presence of grass enemies is too often overlooked, namely, the damage they may do to subsequent crops. Farmers know from real experience that whenever timothy is followed by corn the corn plants will be destroyed by grub worms, cut worms, or wire worms, unless the necessary precautions are taken. The most practicable method of

ridding the field of these worms before the corn is planted is to plow the field in the fall so that the grubs or larvæ are exposed to the winter cold and thus destroyed.

Control of Grass Enemies.—Artificial control of grass enemies is hardly to be recommended except in such case as a concerted attack by billions of insects. For example, a raid by grasshoppers, chinch bugs, army worms, and the like, may require immediate action to check their ravages. Burrowing animals may be trapped or poisoned.

The most practicable and the most effective measures for protection against grass enemies are preventive in character. Crop rotation and clean cultivation of all crops cannot be over-emphasized as feasible and desirable methods of controlling the enemies of grasses. The rotation of crops breaks up the supplying of constantly favorable media for the propagation of these enemies. Crop rotation not only deprives these enemies of their favorable food supply, but also provides a means of exposing them to the rigors of winter to which they succumb. Clean cultivation destroys harboring and breeding media and exposes the insects to conditions inimical to them.

Job 11. Harvesting and Curing Hay

Conditions Usually Found.—(1) Very good and very bad methods of harvesting and of curing hay are found in practically all regions. (2) New and improved methods for handling hay crops are constantly being devised.

Aims.—(1) Students should learn the best methods of harvesting and curing hay crops to suit the particular grasses used. (2) They should learn the use of improved machinery and other equipment.

Problems for Study and Discussion.—(1) Compare the mowers used in your region for cutting hay crops as to length of cutter bar, types of guards, and other features.

2. Inquire of farmers how much hay can be and should be cut in one day.
3. At what degrees of maturity of the grass is the crop harvested?
4. Why do practices differ so much regarding this point?
5. Compare different types of hay rakes as to their suitability to short grass, to tall grass, and to mixtures.
6. Describe a hay loader.
7. Debate the advisability of buying one.
8. Outline the management for cutting and curing hay in as brief a time as possible.
9. Outline the plan where more time is required.
10. What is meant by the sweating of hay in the cock?
11. What plan would you follow in curing timothy hay during rainy weather?
12. Describe a hay-stacking derrick, and other forms of hay-stacking equipment.
13. Describe the use of a power fork in storing hay in a loft.

Activities.—Examine the workings and adjustments of harvesting machinery. Compare the uses of different forms of machines where possible.

Stage at Which to Harvest Hay.—Palatability is an exceedingly important quality that hay should possess. Hay is a valuable feed, if livestock eat it because they relish it rather than because they can get

nothing else. Hay will not be palatable if it is not cut at the proper stage of maturity. Hay is produced to be fed to livestock. If farm animals will not eat it readily in amounts greater than required for maintenance, there is serious doubt of its economic value.

Timothy should be cut before the seed is fully ripe (Fig. 121). The seed should be well formed, because if the grass is cut too early it will have an undue laxative effect when eaten by livestock. Experienced

Fig. 121.—Cutting a fine stand of timothy hay. (J. C. Allen.)
Fig. 122.—This hay loader is attached to the rear of the wagon, enabling this student and his father to work very rapidly. (J. C. Allen.)

feeders claim that early-cut timothy hay is more tender, more palatable, and more digestible than when cut at the stage of full ripeness. As timothy ripens, the stems become more and more fibrous. If cut too late, they are fibrous and tough, and hard to digest. Reliable authorities recommend that timothy be cut just when the seeds are formed.

Orchard grass should be cut within a short time after the blooming period is past.

The best time to cut brome grass is when the heads are in flower.

Sudan grass can be cut from seven to nine weeks after sowing.

Rye grass should be cut as soon as it is fully out in head. It is not relished by animals if allowed to get ripe before it is cut.

Blue-grass is not primarily a hay grass. When harvested for hay, it should be cut in the early bloom stage.

Fescue should as a rule be cut when about ready to bloom or in the early stage of blooming.

FIG. 123.—Stacking hay with fork in the field. Hay is often put into barns in a similar manner, saving much heavy labor.

Redtop may be cut when it is fully in bloom. It may be cut later than this period, but it must not be allowed to become dry and woody before cutting.

Bermuda grass should be cut when most of the stems are in bloom.

Cutting and Curing Hay.—The common practice is to cut timothy, redtop, fescue, or other hay grasses with a horse-drawn or motor-propelled field mower. The scythe is used sometimes when there is only a small patch to be mowed, especially when the patch is stumpy.

Curing hay is probably the most important process involved in harvesting hay. If the curing is not done properly, the hay will lose much of its palatableness. The curing should be accomplished in such manner as to reduce the moisture to about 15 per cent and at the same time to conserve the desirable aroma and bright color of the hay.

If the hay is ripe when cut it will cure more quickly than if green. If the grass is ripe, the ground dry, and the sun bright when the mowing is done, the grass may be cured in the swath. In most cases, however, it is advisable or even necessary to cure the hay in windrows. Sometimes it may be necessary to pile the hay in cocks in order to cure it properly.

The use of the tedder is advised if the crop is heavy and is cut in the early stage. The tedder lifts the mown grass lightly and leaves it lying loosely so that the air can pass through it readily. The tedder is followed with the rake, which puts the hay into windrows.

The loader may be used to take up the hay direct from the swath, when conditions are suitable to this method (Fig. 122). If hay is to be stacked in the field it is often drawn to the stacks by sweeps without loading on to wagons (Fig. 123).

Job 12. Harvesting Seed and Threshing

Conditions Usually Found.—(1) In regions where hay seed is produced for market, farmers usually practise economical methods of handling the crop. (2) Many farmers would doubtless save grass seed if they understood good methods.

Aims.—(1) Conditions required for the harvesting of good crops of grass seed should be understood by students. (2) They should learn good methods of harvesting and managing seed crops.

Problems for Study and Discussion.—(1) If possible, visit local farmers who have practised saving seed crops from the grasses and learn their methods.

2. At what stages of maturity may grass be cut for seed?
3. What special machinery, if any, may be needed for the harvesting of grass seed?
4. Would you prefer a mower, a reaper, or a binder? Why?
5. What losses may occur if grass is cut for seed when too ripe or with improper machines?
6. Which of the grasses are most likely to shatter their seeds?
7. What methods of threshing seeds are used?
8. What yields of seed may be expected from each of the different grasses in your region? Other grasses?
9. In what states are grass seed produced for market? List states for each grass.
10. What prices could be expected for clean seed of the different grasses?
11. Would it pay better to store the seed until the usual seeding season or to sell it as soon as it is threshed?
12. What standards of purity are required for the best prices?
13. Why should farmers growing grass-seed crops use good fanning mills or other cleaning devices?
14. Why should farmers with weedy farms not attempt to grow grass for seed?
15. What uses can be made of the grass "straw" after threshing out seed?

Activities.—Visit places where seed is being harvested and threshed and report on methods. Get samples from each place and compare them for weed seeds and other impurities.

Harvesting Seed and Threshing.—Grasses that are to be cut for seed should be free of weeds at cutting time. It is poor management to permit weeds to grow in grass fields intended for seed, and it is equally

bad practice to harvest weed-infested grasses to be threshed. It may be necessary in some cases to remove weeds by hand-pulling them. The field should be cleaned before the weed seeds mature.

Timothy should be harvested for seed as soon as the seeds turn brown. If allowed to get unduly ripe before cutting, the seeds will shatter badly. Heavy losses from shedding of seed are likely to occur if timothy is left in the shock a long period of time.

The grain binder is the favored machine to use in cutting timothy for seed. The self-rake reaper is used sometimes, but it is not as satisfactory as the binder on account of the extra labor its use entails.

The commonly used grain thresher with special cylinder attachment is used for threshing timothy.

Blue-grass seed should be harvested when the heads turn brown. Either a horse-drawn or a hand-operated stripper is used in harvesting blue-grass seed. The seed must be stored and cured properly to prevent heavy loss of power of germination. The newly stripped seed, if not properly stored for curing, will heat sufficiently within 24 hours to destroy its germinating power. The seed should be spread thinly on a dry surface exposed to the sun or on a dry floor where the air will circulate over it freely.

Fescue is prolific in seed production. The yield per acre varies from 200 to 400 pounds. The method most commonly used for securing the seed is to cut the grass with a grain binder and thresh it with the small-grain threshing machine.

Brome grass should be cut for seed as soon as it reaches maturity, but before the seeds become hardened. It may be cut with a grain binder or with a mower, or the seed may be stripped from the stem. If the grass is cut, the threshing may be done with the ordinary thresher.

Redtop seed may be harvested by using a stripper or by cutting with a binder or a self-rake reaper. The method most commonly used is that of cutting with the binder and threshing with the small-grain thresher. It should be harvested soon after the grain is fully developed.

Orchard grass should be harvested for seed as soon as it is ripe. The indications of ripeness are light yellow tinted heads and a yellowness of the stems some distance below the heads. When cutting for seed the binder is used. The threshing is done with a grain thresher.

Sudan grass is usually cut with a binder when harvested for seed, and is threshed with an ordinary threshing machine. The yield per acre is sometimes as high as 500 pounds.

Rye-grass seed may be harvested by using the grain binder for cutting and the grain separator for threshing.

Job 13. Using Pastures

Conditions Usually Found.—(1) Permanent pastures are often badly misused and poorly managed. (2) Temporary pastures are often not provided. (3) Both temporary and permanent pastures are often well managed and used by the best farmers.

Aims.—(1) Students should learn how properly to manage and use permanent pastures. (2) They should know the special conditions under which temporary pastures can be planned and used economically.

Problems for Study and Discussion.—(1) Examine temporary and permanent pastures in your region and report the systems followed in using them: number of stock per acre, season of use, condition of the field, condition of the stock.

2. Describe the best permanent pasture you can find or have seen or could produce.
3. What bad conditions are found in some permanent pastures?
4. What kinds of livestock are most injurious to pastures when the soil is very muddy?
5. What is meant by a good sod? How is it maintained?
6. Describe the effects of grazing pastures too early in the spring.
7. What grasses in your region will allow the earliest grazing?
8. Outline the plan which you would follow in beginning the use of temporary and permanent pastures in early spring.
9. What dangers may arise for livestock from the grazing of green grain and other luscious pastures?
10. How can such dangers be avoided?
11. What is meant by a summer rotation of pastures for sheep or for other livestock?
12. How does such a rotation help sheep?
13. How does it help the pasture to change the stock occasionally?
14. How soon after mowing a permanent pasture can it be used for grazing?
15. Why do stock leave certain spots ungrazed?
16. When pastures are weedy, how can you manage to avoid dairy cows giving flavored milk?
17. Give the number of animals per acre for each of the types of livestock and for each of the grades of pasture in your region.
18. Describe a good rotation of crops for your region which would provide a temporary pasture a part of each summer.
19. About how long and in what months could such a temporary pasture be used each year?

Activities.—Compare pastures which are neglected or misused with others that are maintained well.

Supplying Plant Food for Pastures.—Too often pastures are not fed adequately. They are neglected and yet are expected to yield satisfactorily. Grass cannot thrive without proper nourishment any better than an animal can develop or keep in good condition without the kind and amount of feed it needs.

Barnyard manure, the droppings from grazing animals, grass and weed clippings left lying on the ground, and commercial fertilizers are the chief means of supplying plant food for pastures. These are applied as a top dressing. The fertilizing of grain crops used in rotation with grasses is an excellent method of providing the grass crop with the nourishment it needs for profitable production.

Distribution of Animals on Pastures.—A grass that is suitable as pasture for horses may not be equally suitable for cows or for sheep.

The horse will eat the class of herbage that he likes best and will leave that which he does not relish. If the different classes of animals are allowed to graze the pasture together or alternately, the field will be eaten down evenly. Placing the different animals on the pasture in rotation has the advantage of lessening the likelihood of contracting parasitic diseases. The parasites that infest sheep do not endanger horses or cattle. The reverse of this is true also. Rotating animals in pastures is commendable; such practice contributes materially to disease prevention and all parts of the field are grazed evenly.

Injury from Grazing too Closely.—Care should be taken to prevent injury to pastures by close grazing. Pastures may be cropped close enough to lessen their capacity for growth. If kept closely grazed, pastures are likely to lose strength through surface evaporation. A closely grazed crop does not provide sufficient vegetation to protect it from the rigors of the winter season. It is advisable sometimes to allow the grass field to reseed itself. For the several reasons given, pasture-lands should be protected from injury resulting from close grazing.

Injury from Pasturing when Soil is too Wet.—If livestock are allowed to graze grass lands when the fields are wet and soft, the pastures are injured severely. The grass is trampled into the soil and the soil becomes impacted to such a degree that growth of the grass is inhibited or, probably, arrested entirely. The tilth of the soil may be rendered unfavorable to the growth of subsequent crops.

Job 14. Feeding Hay Crops

Conditions Usually Found.—(1) Many farmers sell hay on the market when feeding the crop would be more profitable or better suited to a permanent system of agriculture. (2) Both bad and good methods of feeding hay to livestock are found in nearly all regions.

Aims.—(1) Good methods of managing the hay crop for use on the farm should be studied by students. (2) They should be able to plan good systems of balanced farming to avoid depleting of soil by sale of hay, particularly when prices are low.

Problems for Study and Discussion.—(1) What farmers of your region sell hay? What prices are received?

2. What market grades of hay are sold?
3. Among farmers who feed livestock extensively, study methods of feeding.
4. What types of hay racks are found for cattle? For sheep?
5. What losses are found in feeding?
6. Describe the cutting and salting of hay for livestock.
7. Describe a feed rack having a trough in the bottom to catch seed.
8. How can a sheep rack be constructed to avoid getting seed and trash in the wool?
9. Compare the labor involved in supplying hay to racks of different sizes and in different locations.
10. Compare the lengths of racks for sheep and for cattle of different numbers.
11. Describe a good shed for hay racks where loose cattle are to be fed through the winter.

12. Describe a good shed for hay racks where loose sheep are to be fed through the winter.
13. What plans of bedding are used for such feeding?
14. How is the manure handled?

Activities.—Draw plans of good racks for feeding hay in the open and in barns. Calculate cost of each.

Relation between Soil Fertility and Feeding Hay.—If fertility is taken from the soil by growing crops and is not by some means replaced, the soil becomes depleted of fertility. If this process is continued for a period of years, the land becomes less productive and eventually is unprofitable. If the hay crop is not fed to livestock and thus returned to the land, the plant food used up by the growing hay grasses must be replaced in some other way in order to prevent the gradual reduction of the productive power of the soil. Supplying plant food wholly through commercial fertilizers is usually very poor economy. Furthermore, the vegetable matter, which the feeding of hay crops returns to the soil, improves the mechanical condition of the soil and thus promotes aëration and the liberation of inert fertility.

Conserving the Refuse and the Manure.—There are certain parts of the hay that animals will not eat because they are not palatable. The woody fibrous portion is not relished by livestock and is low in nutritive value. This refuse should be conserved and returned to the land.

Unless the droppings from the animals are conserved and returned to the soil, much of the gain to be realized from feeding hay is lost.

Methods of Feeding.—The feeding of hay should be done in such manner as to economize on labor and to prevent wasting of feed. If the animals are fed in the barn, the hay should be dropped from the mow at a point near the feeding racks or from the mow into the racks. The racks should be so constructed as to prevent the animals wasting the hay.

If the feeding is done in sheds or out in the open, provision should be made for handling the hay without unnecessary labor. The feeding equipment should be so constructed as to prevent wasting the hay.

Feeding Hay in Balanced Rations.—The most profitable use of hay is to feed it as part of a balanced ration. Hay is used as the bulky portion of the ration. The quantity needed should be determined with reasonable accuracy and only the amount needed should be fed.

The ration should be determined on the basis of the kind and condition of the animals to be fed and the purpose to be attained. The profit to be derived from feeding hay may easily be turned into a loss by either underfeeding or overfeeding or by using the hay in poorly balanced rations.

Job 15. Baling and Marketing Hay

Conditions Usually Found.—(1) The types of bales vary in different market regions. (2) The methods of selling hay are becoming more complex because of the advent of motor vehicles and machinery. (3) Coöperative methods of selling hay are not as commonly found as for some other commodities.

Aims.—(1) Different types and sizes of bales for hay should be studied by students. (2) They should understand the methods of finding good markets for hay and for seed. (3) Problems of holding baled hay crops should be studied. (4) Coöperative methods which could be used in selling these crops should be considered.

Problems for Study and Discussion.—(1) Ask farmers who have sold hay what sizes of bales are required in the available markets.

2. Give the sizes and weights of bales used in different markets of America.
3. What prices have been received by local farmers for hay of different grades during the last few years?
4. Do farmers consider that the selling of hay is a profitable feature of farm management? Why?
5. What farmers or dealers ship hay to large cities for redistribution?
6. What farmers ship hay direct to mines, road-grading jobs, or other places where horses and mules are used?
7. Discuss with farmers the advisability of holding hay crops for better prices.
8. Make a table with prices quoted in papers in different months of each year for the last five years.
9. What do these figures indicate regarding the advisability of holding your crop?
10. Discuss the possibility of coöperative marketing of hay when a number of farmers are producing this crop for market in the same neighborhood.
11. How could they help each other if they did coöperate?

Activities.—Assist in baling hay. Determine weights and sizes of bales.

Sizes and Weights of Bales of Hay.—The sizes and weights of standard hay bales are classified under three groups: (1) Small bales weigh from 70 to 100 pounds and measure in size either 13 x 18 x 38 or 16 x 18 x 36. (2) Middle-sized bales weigh from 100 to 150 pounds and measure either 17 x 22 x 36 or 18 x 22 x 36. (3) Large-sized bales weigh from 150 to 250 pounds and measure 28 x 28 x 46. The most popular bale sold for shipment weighs about 100 pounds.

Baling Hay.—Hay is baled by forcing it into a rectangular box-like groove and compressing it by means of a lever operated on the principle of a horizontal piston. The bales are bound securely with wire while under compression.

The power for operating the pressure lever is supplied by a steam or gasoline engine or by a horse-drawn sweep.

Hay intended for shipment is baled to facilitate handling. A ton of hay in the stack requires from 350 to 500 cubic feet of space while a ton of baled hay requires from 100 to 150 cubic feet. Baled hay can be handled more rapidly and with much less waste than loose hay. The latter is often sold in local markets (Fig. 124).

Marketing Hay.—Timothy is the standard hay on all markets. The National Hay Association has adopted rules for grading timothy hay.

Under these rules there are five grades of timothy hay: Choice, No. 1, No. 2, No. 3, and No-grade.

The choice grade consists of not less than nineteen-twentieths timothy hay that has bright natural color, is properly cured, is sound and well baled.

Number one grade must be sound, well baled and of good color, not stained. It must be properly cured and must be at least seven-eighths timothy, the seed must not be developed beyond the early dough stage.

Number two grade must be not less than three-fourths timothy, must be of fair color, not stained, must be sound and well baled.

Number three grade consists of all hay that is sound and well baled but that otherwise falls below the standard of either Choice, No. 1, or No. 2.

FIG. 124.—Timothy hay is sometimes hauled to local markets in loose loads, especially where good roads may be used. This saves the time and cost of baling. (J. C. Allen.)

No-grade hay includes all hay that does not measure up to the standard of No. 3 hay. The No-grade hay is unsound, is stained, and is badly cured.

There are grades of other hay that have been standardized by the National Hay Association. The prices for these other hays are governed in large degree by the price of timothy and the availability of these other varieties.

A large amount of low-grade hay is placed on the markets. Weed infestation and improper curing account for most of the undesirable low-grade hay. Mixture percentages and foreign material are estimated by weight.

Things to Make at Home.—Repair wagon hay rack; device for holding lines on front of hay rack; paint and oil mower; paint and repair hay rack.

CLOVER ENTERPRISES

By Z. M. Smith

Analysis into Jobs.—The growing, curing and use of hay, the production of seed, and the marketing of the crops are included in this treatment. The true clovers here considered are red, mammoth, alsike, crimson and white. References are to U. S. Farmers' Bulletins. See also *Forage Crops* by Piper.

1. Determining possibilities with a clover crop.
2. Choosing the type of clover to grow. 579, 693, 1142, 1151.
3. Choosing soil, field, acreage, and rotation. 1142, 1339.
4. Securing good seed; cleaning; testing.
5. Buying and mixing fertilizers.
6. Preparing the field for sowing.
7. Liming the field. 921.
8. Inoculating soil or field.
9. Sowing and fertilizing.
10. Caring for clover; pasturing; cultivating.
11. Controlling enemies. 971, 1365, 1484, 1510.
12. Harvesting and curing hay.
13. Harvesting seed and threshing. 676, 1142, 1411.
14. Using the crop for feed and manure.
15. Baling and marketing.

Job 1. Determining Possibilities with a Clover Crop

Conditions Usually Found.—(1) In regions where these crops are well understood most farmers grow them profitably. (2) In regions where the crop is new, farmers are often timid about attempting it.

Aim.—Students should consider the economic factors involved in growing one of these crops before deciding to undertake any of them.

Problems for Study and Discussion.—(1) Ask a number of farmers of your neighborhood their opinions regarding each of these five true clovers.

2. What uses are made of each of these grown in your region?
3. What yields are commonly obtained with each?
4. What criticisms are brought against any of them?
5. Which seem best to suit their local rotations?
6. How long does each crop last in your region?
7. Are local soils considered satisfactory for successful growth?
8. What special fertilizing or liming is required for these crops on your soils?
9. On a map of the United States locate the area for each of these clovers.

Clovers as Feed for Livestock.—Clover of one variety or another will grow in practically every part of the United States. This crop will not thrive equally well in all regions, but in every region one or more varieties suited to the soil and climate will produce profitably if properly managed.

Clovers are valuable as feed for animals. They are much richer in protein than any of the grasses. When properly cured and stored they make palatable hay. They make excellent pasture for all kinds of farm animals (Fig. 125). Clovers are an excellent means of supplying protein for young livestock. In regions especially adapted to clovers, it is cheaper to supply protein for growing animals by the use of clovers than to feed commercial concentrates.

Clovers as Soil Improvers.—Clover crops play an important part in approved soil management. Their roots penetrate the soil deeply and draw from the store of plant food in the subsoil. The decayed roots of

Fig. 125.—A blue-grass and white-clover mixture is hard to beat for sheep. (J. C. Allen.)

the clover plant add organic matter to the soil, increasing its water-holding capacity and making it more friable. The tap root, lateral roots and sub-rootlets of the clover plant so thoroughly ramify the soil that aëration is promoted and drainage is facilitated. The soil is broken by the network of clover roots so that the percolation and the capillary action of water are favorably influenced.

Clovers have the power to gather nitrogen from the air and store it in the soil. In this manner one of the highly important foods for other farm crops can be supplied. Commercially purchased nitrogen is expensive in comparison with nitrogen supplied by clover bacteria. Furthermore, commercial fertilizer does not improve the mechanical condition of the soil by providing organic matter.

Clovers in Rotation.—Clover is excellent for use in rotation with other crops such as corn, wheat, oats, rye. It is valuable in rotations because it improves the soil and because it is a very desirable feed for livestock.

Clover is adaptable to use in rotations. For example, corn followed with wheat which in turn is followed with clover is an approved rotation in the corn belt. The clover may be pastured lightly after the wheat has been harvested, if soil and weather conditions are favorable. The following year the clover will furnish pasture or it can be cut for hay and seed. The soil is thus made to yield a crop of some kind annually without the undesirable result of depleting the fertility of the soil.

Clover with Grasses.—It is sometimes advisable to sow clover with grasses. In the corn belt it is common practice to sow clover with timothy. The hay is relished by livestock. This mixture makes good pasture for farm animals. The second year the timothy will have supplanted the clover and the crop can be harvested for either timothy hay or timothy seed.

Job 2. Choosing the Type of Clover to Grow

Conditions Usually Found.—(1) Farmers who understand these clovers are able to choose between them readily. (2) Many farmers and students are not familiar with the special values of each of these clovers.

Aims.—(1) Breeders should study the different clovers and know their special uses and values. (2) They should know which of these will best suit their rotation systems and other farming plans.

Problems for Study and Discussion.—(1) From the studies made in the preceding job decide which of these clovers would best fit a four-year or a three-year rotation of crops.

2. Choose which crops would be best suited for permanent pasture.
3. Which would be best for use in producing organic matter for the soil in your rotation? Why?
4. Which would be best for use as a winter cover crop? Why?
5. Find the cost of seed of each of these types of clover. Find the rate of seeding for each.
6. What yields of seed may be expected if the crops are successfully grown for this purpose?
7. What are the yields of hay from the clovers grown for this purpose?
8. Compare the quality of hay from crimson, red, mammoth, and alsike clovers.
9. Make a list of the clovers which you would prefer to grow for each of the purposes, with the use you would make of each.

Activities.—Collect samples of all the clovers. Dry them and mount them for study at home or at school.

Deciding the Purpose of the Clover Crop.—The purpose to be served by the clover crop is perhaps the most important consideration in determining the type of clover to grow. Some clovers are especially adapted for permanent pasture and some are poorly suited to this purpose. There are occasions when the soils need an abundance of organic matter.

The clovers are not equal in their ability to produce vegetation. Some will produce twice as much herbage as others.

The rotation system best adapted to a given farm will greatly influence the selection of the type of clover to grow. The clover that best fits into the rotation plan is the one that should be chosen.

Whether the primary purpose to be served is seed production, pasturage, or hay, the choice of type of clover requires careful attention.

Adaptation to Soil.—The different clovers will not thrive equally well on all kinds of soil. The most profitable returns will be realized when the type of clover is selected that is best suited to the soil to be seeded.

Adaptation to Climate.—Clover can be grown in all parts of the United States, but it will flourish better in some regions than in others. Moreover, the different varieties of clover will not grow equally satisfactory in all regions. It is important that the farmer take proper cognizance of the fact that he should choose the variety or varieties best suited to the climate of his section.

Red Clover.—This variety is sometimes called medium red clover, probably for the reason that it is intermediate in growth between the smaller varieties and the mammoth.

Red clover is especially adapted to the temperate zone and to a moist climate. It can be grown in almost every section of the United States. However, it will thrive best in the territory lying approximately between 37 and 50 degrees north latitude. It is within these latitudes that it has been found profitable, although it can be grown with profit both farther north and farther south where temperature and moisture conditions are favorable.

Red clover is not excelled by any other variety in America in its ability to produce pasture. It grows rapidly, and when it is supplied with moisture evenly distributed throughout the growing season its growth is persistent. For the same reasons that it produces abundant pasturage, it is unexcelled by other clovers as a soiling crop.

For the most part, red clover is a biennial. Under favorable treatment and climatic conditions it may be a perennial. Pasturing the plant under proper management tends to prolong its life, while harvesting it for seed produces the opposite effect.

Mammoth Clover.—This variety is similar to red clover in its special adaptation to a temperate and moist climate. It will withstand drouth better than red clover, probably because it roots deeper.

Mammoth clover is ordinarily biennial in its habit of growth. Under some conditions it is perennial, but as a perennial it is not long-lived.

This clover is relished by livestock. The hay is not equally adapted to all classes of domestic animals. The stems are somewhat coarse for sheep.

Unless the hay is properly cured and stored it will be too dusty and too dry for horses.

Mammoth clover gets its main growth the first part of the season. It makes comparatively little growth as a pasture after mid-season and makes scarcely any growth within the season after a hay crop has been harvested.

Mammoth clover was introduced into America from Europe many years ago, but only recently did it assume considerable importance in the United States.

FIG. 126.—A fine stand of Alsike clover. This student evidently prepared his land very carefully and secured seed free from weeds.

This clover is excellently adapted to soil improvement because it produces an abundance of vegetable matter and because its strong root system enables it to gather large amounts of nitrogen from the air and store it in the soil.

Alsike clover is less luxuriant in growth than red clover (Fig. 126). The region to which it is best adapted lies farther north than the median latitude of the red clover area. The boundary line between the United States and Canada is probably slightly north of the latitude at which this clover thrives best. Relatively humid and cool climatic conditions favor the growth of alsike clover. Hence the areas slightly south of 54 degrees north latitude and bordering on the Atlantic and Pacific oceans and the

Great Lakes are most conducive to the profitable production of this crop.

The stems of this plant are more slender than those of the red clover, and its roots are more fibrous. The alsike plants do not grow as rapidly as do the red clover plants, nor do they grow as vigorously the latter part of the growing season. Seldom does alsike produce the second cutting of hay within a season. The plant is a perennial and will live several years under favorable conditions.

Alsike is pre-eminently a honey plant. As a bee pasture it is unequaled by any other clover except perhaps the white varieties.

Crimson Clover.—This plant has oblong, cylindrical, or cone-shaped heads while the red clover has globular heads. The color of the bloom is scarlet or crimson of the deepest hue. Its root system is strong.

Crimson clover is an annual. It makes an excellent catch crop and is equally desirable as a cover crop among fruit trees.

Crimson clover may be used as a soiling crop, as pasture, as hay, or as silage. It is not as commonly used for hay as for a soiling feed because curing it is difficult at the time of year when it makes a desirable grade of hay.

This clover is unsuited to a severe climate. It requires considerable moisture. It is best adapted to the area immediately south of the heart of the blue-grass region and to a few other regions possessing equally suitable climate and soil.

Crimson clover may be used to improve the soil because it will supply a large amount of vegetable matter and will increase the amount of nitrogen in the soil.

White clover is perennial. It is not a hay crop because it does not grow tall enough for this purpose. It is excellent for pasture when grown in combination with blue-grass. It spreads because of its trailing habit and on account of the abundance of its small seeds. Under favorable conditions this plant will grow and produce bloom throughout the growing season. It is the only clover that rivals alsike as a pasture for bees. It is commonly used in lawn-grass mixtures.

White clover has the power of wide adaptation to climatic conditions. It thrives best, however, in a moist climate in the northern states and in certain other areas possessed of like climatic conditions.

Job 3. Choosing Soil, Field, Acreage, and Rotation

Conditions Usually Found.—(1) Farmers often grow one of the clover crops where the soil needs improving rather than choosing the best soil for it. (2) Several of the clovers are used in regular rotations and the area is determined by the farm balance and the rotation adopted. (3) White clover is usually grown in permanent

pastures and lawns. (4) Crimson clover is used chiefly as a winter crop or to produce seed for market.

Aims.—(1) Students should understand the problems of establishing rotations suitable for using clovers. (2) They should know what conditions of soil, drainage and fertility are necessary for the success of these crops. (3) They should know the time required for establishing each of the clover crops.

Problems for Study and Discussion.—(1) Ask local farmers to give their choices between red clover, mammoth clover and alsike clover for use in farm rotation systems.

2. Compare these three in character of growth and suitability to good rotation plans.
3. Compare red clover and mammoth clover in their suitability to rather poor soils.
4. Compare these two with alsike clover in regard to need of lime.
5. If you had a farm which was partly upland and partly river-bottom or creek-bottom land, how would you plan the rotation so that one of these clovers could be used every third or fourth year on each field?
6. Ask farmers regarding the area of clover grown each year during the last five years.
7. Determine the average size of field for each farmer and for all whom you ask.
8. Why do some farmers allow the area to vary so much?
9. If possible, devise a plan for each of these farmers which would improve his system.
10. For your own farm make a plan which would keep the area of clover about constant year by year.
11. Give the conditions of soil, drainage and fertility best suited to each of these clovers.
12. How can clovers be used as soil builders?
13. Under what conditions in your region would you have a permanent pasture and grow white clover in it?
14. Under what conditions in your region would you grow crimson clover as a sod improver or as a winter cover?
15. What other crops should be sown with crimson clover when used for these purposes?

Activities.—Tabulate the sizes of fields, kinds of soil in each case, the number of years in each rotation, and the kinds of clover grown in your region.

Comparing Use of Crop to Location.—The selection of the field to be seeded to clover should be influenced in no small degree by the use to be made of the crop. If an abundance of hay or pasture or seed is the objective, a field should be selected that has a fertile, well-drained soil that is non-acid. The acreage for hay or pasture crops should be determined primarily on the basis of the size of the farm and the number of animal units the farm will carry in a balanced system of farm management.

If permanent pasturage is sought, the suitability of field location is an important factor to be considered in choosing the field to be seeded. Accessibility to water and shelter and convenience in transfer of animals to and from pasture are important.

Because clovers are highly adapted to improving the fertility and mechanical condition of soils, this objective will be the chief consideration many times in making the choice of the field to be seeded.

Rotation plans affect choice of field and acreage. A farmer who has wisely determined his system of crop rotation and has developed a well-balanced farm management plan will seed his fields to clover in accordance with these plans, if they are not interfered with by circumstances beyond his control. In like manner the acreage will be determined from time to time.

It may be desirable in many cases to make provision in the farm management plans for the several uses of clover, to the extent that soils and climate are suitable to these different uses. For example, a field may be selected one year because a catch crop is needed; at another time a seed or a hay crop may be required to maintain the proper balance in farm management; and at somewhat regular intervals provision should no doubt be made for the use of clover primarily as a means of soil improvement.

Rotation plans may be disturbed by unfavorable weather conditions for clover. Dearth of rainfall may cause the loss of a field of young clover, or a clover crop may be destroyed by freezing and thawing and the consequent heaving process that uproots the plants. Sometimes a clover crop is killed by excessive cold at a time and under conditions when the plants are least capable of withstanding freezing weather. If any one of these conditions arise, the choice of the field and the acreage for clover will be directly and materially affected.

If, on the other hand, the loss of a clover crop and the consequent disrupting of crop-rotation plans result from lack of drainage, lack of lime, lack of fertilization, abuse in pasturing, or other causes that can be controlled, these unfavorable conditions should be corrected immediately. So far as possible the farmer should keep under his control the conditions that should primarily determine the choice of field and acreage for his clover crops.

Job 4. Securing Good Seed; Cleaning; Testing

Conditions Usually Found.—(1) Too often very careless methods are used in securing clover seed for use in the farm rotation. (2) Where only occasional sowings are made, better seed is often bought in the market.

Aims.—(1) The importance and methods of securing good seed should be understood by students. (2) They should practise cleaning and testing seed before sowing.

Problems for Study and Discussion.—(1) Find the practices of local farmers regarding the seed used for starting the clover crops.

2. Describe some of the best and some of the poorest methods you can find.
3. In what states are the different clovers chiefly produced for market?
4. Which kinds of clover seed would you advise farmers to buy in the market for your region?
5. Why should samples of clover seed be examined before buying?
6. Describe a good method of examining seeds for weeds and other impurities.
7. What is meant by "standard" seed in the market?

8. In regions where clover seed is produced why should farmers clean it before sowing?
9. Describe the cleaning of seed with a fanning mill. Calculate cost.
10. Locate suitable machines in your region for this purpose.
11. Find the cost of such machines.

Activities.—(1) Test seeds by the method recommended by your station. (2.) Clean seeds with a fanning mill, if possible, and calculate the percentage of good seed. (3) Examine samples of seed with a hand lens or with sharp eyes and calculate the percentage of good seed in each sample. Identify weed seeds present.

Using only Good Seed.—It is unprofitable to sow clover seed that will not test a high-per-cent germination. The rental value of the land, the taxes on the land, the interest on the investment, and the value of man and horse labor required are the same whether good or poor seed is used. Other conditions being equal, the labor income from a clover crop depends upon the quality of seed sown, or, in other words, the profitableness of the clover crop is determined by the viability of the seed used.

The source of the seed should be known. Only producers and dealers that have established a record for marketing none but high-grade seed should be patronized when purchasing clover seed. In the absence of such a record, the recommendation of the state agricultural experiment station regarding sources of clover seed should be followed.

The farmer should take advantage of whatever protection from undesirable sources of seed supply is afforded him through pure-seed laws.

Cleaning Seed.—Clover seed produced on the home farm or seed purchased from a neighbor should be cleaned. No matter how careful the grower may have been in his efforts to keep his clover field free from weeds, more or less weed seeds will be found in the clover as it comes from the huller. If the seed supply is purchased commercially, the cleaning process should have been completed before placing the seed on the market.

Weeds in clover seed not only contaminate the soil and interfere with the profitable production of subsequent crops, but they lessen the chances of the successful growth of the clover. Furthermore, when weed seeds are left in the clover seed, the purchaser pays clover-seed prices for the weeds.

Clover seed should be cleaned to free it from dead seed, chaff and inert foreign matter. As in the case of weed seeds, the farmer cannot afford to purchase such useless material. Furthermore, it often happens that such substances interfere with the operation of the clover seeder.

Unless the farmer owns or has access to a fanning mill that will eliminate all impurities, he should have his clover seed cleaned commercially by a competent and dependable operator.

Testing Seed.—Clover seed purchased commercially should bear a tag certifying to the percentage of germinable seed as determined by reliable tests.

If the farmer uses home-grown clover seed or seed purchased from his neighbor, he should test the seed by a method recommended by his state agricultural experiment station. In many instances assistance in making the test may be secured through the county agricultural agent or the teacher of vocational agriculture.

Two kinds of test are desirable. One is for the purpose of determining the percentages of weed seeds, inert matter, and other impurities. This test is made by a careful inspection of samples of known weight, by which process the various impurities are separated into their proper classifications, their weights determined and their percentages calculated.

The second test is the one used to determine the germinable quality of the clover seed.

Job 5. Buying and Mixing Fertilizers

Conditions Usually Found.—(1) Farmers seldom fertilize soil for clovers. (2) In some regions some commercial fertilizer is needed in order to grow clover successfully at first.

Aims.—Students and growers should be able to determine the conditions requiring the use of fertilizers. (2) They should know how to buy fertilizers economically and mix them properly.

Problems for Study and Discussion.—(1) What soils of your region are so poor as to require fertilizer to start any of these clover crops?

2. For which of the clovers is fertilizer sometimes used in your region?
3. Try to locate fields where fertilizer would help in starting clover.
4. To what extent is commercial fertilizer used as a top dressing on pastures? Do you know of places where this would help?
5. What fertilizers would you use in making a suitable mixture for a poor pasture or other poor soils where clover is to be grown?
6. Under what conditions may it be advisable to home-mix fertilizers?
7. What experience have farmers of your region had in purchasing fertilizers coöperatively?
8. How should you proceed in determining the fertilizer formula to use in starting a clover crop or in top-dressing a growing clover crop?
9. What services should farmers expect from their county agricultural agent and their state station in connection with the profitable use of fertilizers on clover crops?

Activities.—Collect fertilizer tags and compare formulas recommended for your region. Obtain prices of each and of materials which you might mix.

Buying Fertilizer.—Fertilizers are needed in some instances to make the clover crop profitable. The kind and amount of fertilizer actually needed should be determined on the most reliable basis available. The safe procedure for the farmer to adopt is to become familiar with and follow the recommendations of his state station. (See Appendix.) Important as it is to know what formula to use, it is equally important to know where the proper fertilizer can be purchased. Farmers in many instances have found it profitable to pool their orders for fertilizers. They are allowed a reduction in price when they purchase in carload lots. In addition to reducing the price, the coöperative plan reduces the overhead

expenses incident to handling fertilizers from the manufacturer to the consumer.

The farmer should not overlook the fact that low-priced fertilizer may be the most expensive. The percentage of available plant food in the mixture may be low and the percentage of carrying material may be high. The important consideration is the amount of usable plant food purchased and not the bulk or weight of material.

Mixing Fertilizers.—If the farmer can find on the market the fertilizer mixture that conforms to the formula best suited to his need, and if the purchase price is on a level with the actual value of the plant food in the mixture, it is doubtful whether he needs to purchase the ingredients separately and mix them himself. There may be instances, however, that justify home mixing of fertilizers. The formula may be simple, the needed ingredients may be available in such form and quantity that the price is comparatively low, and a suitable and inexpensive carrying material may be at hand. Methods of mixing are described in the corn section.

Job 6. Preparing the Field for Sowing

Conditions Usually Found.—(1) Clovers used in rotations are most commonly sown with the use of small grain as a nurse crop, no extra preparation for clover being made. (2) Farmers usually prepare soil well where clover is to be sown by other plans.

Aims.—Students should learn the most economical methods of managing the soil for the successful growth of clovers.

Problems for Study and Discussion.—(1) Find the different methods of starting clover crops used in your region.

2. Under what conditions are the clover crops ever started without a nurse crop of small grain?
3. What proportion of the farmers use small grain as a nurse crop for clover?
4. Describe the best plan of preparing the soil for grain when clover is to be sown in it.
5. Describe the best preparation of soil where clover is to be sown without small grain.
6. Give the seasons for sowing clover in small grain; when sown alone.
7. What is meant by a firm seed bed? By a loose seed bed? Which would you prefer for clover seed? Why?
8. Tell of ways of preparing a firm seed bed.
9. Compare harrows and compare rollers for use in this job.

Preparing the Seed Bed.—For clovers the seed bed should be in fine tilth if the crop is seeded openly or if sown at the time a nurse crop is seeded. If it is sown on top of the ground where a nurse crop is growing, the soil should be pulverized finely for planting the nurse crop. Stiff clay soils, because of their impacting tendency, will not bear the fineness of tilth suitable to sandy loam and similar soils.

Sandy soils, or soils so light in texture that they are susceptible to lifting by winds, or soils that are likely to wash unduly, should be put in

tilth for the seeding only a short time before the seeding is done. Soils of this type sometimes require impacting to prevent undue shifting by the wind and to retard the movements of soil water downward.

The seed bed should be clean when the crop is seeded. This condition can be obtained by clean cultivation of the nurse crop or by cultivation for the elimination of all weeds when the clover is seeded openly.

The soil to be seeded to clover should be under-drained to promote aëration, to retard uprooting of the plants by the process of heaving, to influence favorably the capillary action of water, and to promote activities

FIG. 127.—"George (standing) and Dale Simmons, ages 19 and 17 respectively, both graduates of vocational agriculture, live on a 160-acre farm, Hancock Co., Ind. Over a five-year period their corn-project yields have gone as high as 90 bushels an acre and never lower than 66 bushels. In each case clover was plowed under for the corn crop. They are seen here preparing a seed bed for oats, in which crop clover will be seeded to prepare for future hay, pasture and corn crops. They drove nine miles to high school for four years. Both boys have been members of champion corn and livestock judging teams. Each will continue farming as his vocation." (W. C. Kolb, Vocational Agriculture Instructor.)

of nitrogen-gathering bacteria. Seed-bed preparation for any of the clovers is influenced largely by the weather, the season, and by the preceding crop (Fig. 127).

The type of soil best suited to a given variety of clover must of necessity be taken into consideration when the seed bed is being prepared. The soil highest in adaptation for red clover is a moist clay loam, moderately supplied with humus, and underlaid with a subsoil of moderate capacity for drainage and for retention of moisture. Under favorable conditions this type of soil can be put in fine tilth for clover seeding without too much labor. A thorough harrowing after the land has been plowed will often fine this type of soil sufficiently for reception of the clover seed.

White clover seems to thrive best on clay loams in regions having a moderately moist and cool climate. Sometimes the conditions are such

that fall plowing is advisable. When the ground is plowed in the autumn, the freezing and thawing that follow disintegrate the soil particles and promote friability. If the crop is to be seeded openly it may be advisable to level the surface by harrowing lightly after the plowing has been completed. If undue impaction is caused by heavy rainfall before early spring seeding, it may be necessary to disk the ground.

Alsike clover is usually at its best in a moderately friable clay loam possessing plenty of moisture. If the soil is plowed under conditions that produce cloddiness, it may be necessary to use the roller to crush the clods before disking or harrowing.

Mammoth clover usually thrives best in soils that are well adapted to the production of red clover. The seed-bed treatment most favorable for red clover is best for mammoth clover.

Crimson Clover.—Sandy loam soils are better adapted than other types to the production of crimson clover, other important factors being equal. As other clovers, this variety requires a finely pulverized seed bed, although possibly the preparation does not need to be as fine as for others.

Job 7. Liming the Field

Conditions Usually Found.—(1) A limiting factor in producing a clover crop is acidity of the soil. (2) Although farmers may know their soil is acid, they do not in all cases take the necsssary steps to correct the condition.

Aims.—(1) Farmers should know the importance of non-acidity of soil as a condition for growing clover. (2) They should know how to determine the degree of acidity and the amount of lime required to neutralize the acid in the soil. (3) They should become familiar with approved methods of applying lime.

Problems for Study and Discussion.—(1) Under what conditions should soil be limed before seeding to clover?

2. What are approved methods of determining soil acidity?
3. How can you determine the amount of lime to apply to the acre?
4. How would you determine the kind of lime to use?
5. At what time should the lime be applied?
6. How frequently should lime be used?
7. Describe the process of spreading the lime.
8. Where can lime be procured? Obtain prices.

Activities.—Collect samples of lime of different kinds. Tabulate the kinds of lime, showing cost and neutralizing power of each.

Using Lime.—Clover crops will not thrive in acid soils. One of the principal conditions for the growth of clover is the presence of nitrogen-gathering bacteria in the nodules on the roots of clover. These bacteria cannot thrive if the soil is acid. They require a neutral or slightly alkaline soil. (See corn enterprise for methods of testing soils for acid or need of lime.)

One of the most important functions of clover is to increase the nitrogen content of the soil. For this reason it is necessary that conditions favorable to bacterial growth be established and maintained. Bacteria favor-

able to clover gather nitrogen from the air for the host plant. The nitrogen thus gathered becomes fixed in the soil where it is available for subsequent crops.

Lime is the agent used for correcting soil acidity. It possesses the power to neutralize the acid and thus produce conditions favorable to bacterial action (Fig. 128).

The presence of acid in soils interferes in many cases with the release of plant-food elements for clover or other crops. It is thought that certain substances, poisonous in their effects, collect in the soils and

FIG. 128.—Field of young clover on the farm of Peter Schebler, Hamburg, Indiana. Two tons of limestone per acre were applied to this field in the wheat the preceding fall. The light strip across the field where the clover failed to catch and which is grown up in grass was a row of shock corn at the time the limestone was applied and therefore received none of the limestone. These corn rows could easily be traced across the field by the absence of young clover.

become harmful to growing plants. The harmful effects of these substances may be counteracted by the use of lime.

Lime improves the tilth of heavy soils and thus promotes soil aëration and drainage. The mechanical condition of the upper layer of the soil is of great importance in crop production. The tilth of the soil not only affects aëration and drainage but greatly influences bacterial growth and action.

Applying the Right Kind.—There are different kinds of lime that may be used for agricultural purposes. Carbonate of lime may be used

in the form of air-slaked lime, pulverized limestone, marl, or other carbonate materials. Lump or burnt lime is sometimes used (Fig. 129). Hydrated lime is preferred in some instances.

Finely divided material will give results more quickly than will coarse material. For immediate effect a finely divided form of lime should be used, such as hydrated, lump, or air-slaked lime. More effective action

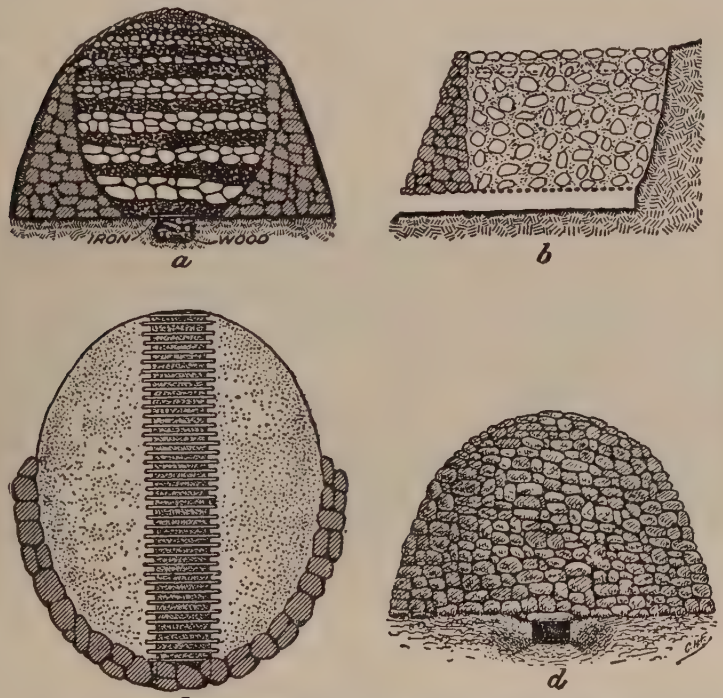

FIG. 129.—Details of construction of a farm limekiln: *a*, cross section, showing layers of rock and coal; *b*, longitudinal section, showing side hill used as back wall; *c*, ground plan, showing trench and grate; *d*, completed kiln, walled in and plastered with mud. (U. S. Dept. Agr.)

is provided by finely pulverized limestone than by limestone that is coarsely crushed.

Using Enough Lime.—The amount of lime to apply depends upon the degree of soil acidity and upon the texture of the soil. For light soils that are slightly acid one ton of pulverized limestone or of air-slaked lime, or from one-fourth to one-half ton of lump lime per acre is recommended. From two to four times these amounts should be applied if the soil is strongly acid.

For heavy soils that are slightly acid the rate of application should be one and one-half tons of pulverized limestone or other high-grade carbonate, or from 500 to 750 pounds of lump or hydrated lime. From two to three times these amounts may be required for soils of strong acidity.

Applying Lime.—Lime should be spread on top of the soil and should be thoroughly mixed with the soil. Harrowing is an effective method of incorporating lime with the soil. Disking is recommended in some instances. The most convenient method of spreading lime is the use of a lime spreader (Fig. 130). The spreading may be done by hand direct from the wagon or from piles placed at convenient intervals over the field.

FIG. 130.—Student spreading lime on an Indiana clover project. The lime is unloaded from the cars into piles in the field, and from them distributed as the student has time, using a lime spreader attached to the end-gate of the wagon. (J. C. Allen.)

Job 8. Inoculating Soil or Field

Conditions Usually Found.—(1) In regions where clover has been grown extensively, the soil has become inoculated with the proper bacteria. (2) In regions where clover is being introduced, it is advisable to inoculate.

Aims.—(1) Students should understand why inoculation with proper bacteria is essential to clover production. (2) They should become familiar with the best methods of inoculation. (3) They should know how to determine whether the soil is properly and sufficiently inoculated for growing clover successfully.

Problems for Study and Discussion.—(1) What part do bacteria play in the growing of clover?

2. How can one tell whether the soil is inoculated with the proper bacteria for clovers?
3. What are the approved methods of inoculation?
4. Briefly describe each method. Which method will you use?
5. How many clover-production failures in your region due to lack of proper inoculation do you know of?
6. What relation do bacteria favorable to clover production bear to the maintenance of soil fertility?

Activities.—(1) Dig roots of clovers or other legumes, rinse in water, and examine for nodules. (2) Inoculate seed by the agglutination method.

Securing Clover Bacteria.—The legumes possess the common characteristic of being able to extract nitrogen from the air and store it in their tissues. Increasing the nitrogen content of the soil is one of the important uses of clover. The nitrogen is gathered by bacteria that live in the soil. They form nodules on the roots of the clover plant and within these nodules they perform their activities and fix the nitrogen. Clover seldom thrives without their presence. These bacteria perform the double function of providing something necessary to the growth of the clover plant and of storing in the soil a supply of nitrogen gathered from the air.

Clover is not a host plant to all varieties of nitrogen-gathering bacteria. For example, the bacteria that are favorable to alfalfa are not of the same variety as those that use clover as a host.

Unless the required kind of nitrogen-fixing bacteria is in the soil when the clover seed is sown, it is necessary to inoculate the soil with these bacteria. After the soil has been inoculated, the bacteria used in the inoculation process multiply themselves rapidly. They increase sufficiently in a few years to make the inoculation permanent.

Inoculating.—There are several methods of inoculating the soil with nitrifying bacteria. The *agglutination method* is described in the alfalfa enterprise. This is probably the easiest and best method.

One of the old methods consisted in taking *soil from a field* on which clover had been growing and scattering it on the field to be seeded to clover. From 200 to 800 pounds of the inoculated soil was distributed over each acre of the new field. Unless inoculated soil is obtainable near at hand, the expense of transportation prohibits the use of this method.

A method of soil inoculation preferred by some is the *use of a culture* medium. The bacteria are grown artificially in the medium. The culture may be shipped in either liquid or dry form. Before it is used the culture is placed in water containing a small amount of sugar and other material that will promote bacterial growth. The bacteria multiply rapidly. In a day or two the mixture is ready for use. It can be sprinkled on the clover seed or it can be mixed with some soil. The sprinkling is to be preferred. The inoculated seed should be dried in a shady place before sowing on the field.

A method that may be used with success is the use of a small amount of *clover seed with grass crops* each year for a few years before seeding to clover. Because the nitrifying bacteria increase in number rapidly, the field will have become inoculated before the clover seeding is done.

Job 9. Sowing and Fertilizing

Conditions Usually Found.—(1) As a rule farmers follow the practice that is common in the community with reference to sowing and fertilizing clover. (2) The progressive farmer studies his soil conditions and is guided by these conditions and the recommendations of recognized authorities when making plans for sowing and fertilizing his clover.

Aims.—(1) Growers and students should possess the most reliable information that has been established relative to clover seeding and fertilization. (2) They should form the habit of applying this information in actual practice on their own farms.

Problems for Study and Discussion.—(1) When should clover seeding be done?
2. How should clover seeding be done?
3. At what rate per acre should clover be sown?
4. How should you determine the kind and amount of fertilizer to use?
5. At what time should fertilizer be applied?
6. How should fertilizer be applied?
7. What are the problems of fall seeding? Of spring seeding?

Activities.—(1) Adjust grain drills and other seeding implements. (2) Practise using some of these.

Sowing at the Right Time.—More clover is seeded in the spring than at any other season of the year. There is a tendency in the corn belt section to increase the acreage seeded at the time of the last cultivation of the corn crop. When the seeding is done in the spring, the common practice is to scatter the seed on land on which is growing a crop of wheat or rye or which is being seeded to oats, barley, or spring wheat.

Under favorable climatic and weather conditions clover may be seeded with success in the summer or in early autumn. Temperature and rainfall must be favorable for summer or autumn seeding, otherwise the crop may fail from drouth or freezing.

Sowing Clover by Best Methods.—When clover is seeded on a growing crop in the spring, the common practice is to scatter the seed before the frost has left the ground. The soil becomes honeycombed by alternate freezing and thawing and the seed become covered by the heaving and settling of the soil and the action of spring rains.

If the seeding on wheat or other winter crop is not done until after the frost is out of the ground, the land should be harrowed lightly before the seed is scattered and the seeding should be followed with a light harrowing to cover the seed.

If a spring nurse crop is used, the clover seed may be scattered after the nurse crop has been sown, and should be harrowed in lightly. Sometimes the clover is seeded with a grain-drill seeder attachment, which usually is constructed to deposit the seed behind the grain tubes.

Clover seed are small and for this reason should not be covered deeply. When sown on heavy soils, the seed should be covered less than an inch as a rule. On light soils the depth of burying the seed will vary from one to three inches, the depth varying with the degree of lightness of the soil.

One method of scattering clover seed is to use a hand machine. Other methods are sowing by hand, using a grain drill, and using a grain-drill seeder attachment. The one of these means selected will depend upon several things, such as sowing with or without a nurse crop, sowing on a growing nurse crop, the depth of covering the seed, sowing alone or in combinations.

Sowing Enough Seed.—Several things must be taken into consideration in determining the amount of clover seed to sow. If the climatic conditions are such as to make the growing of clover difficult, more pounds of seed per acre are required than if those conditions are favorable. The sizes of the seed very materially influence the amounts to sow. The smaller the seed the less the amount required. For example, about one-half as many pounds of alsike seed will be needed per acre as would be needed if red clover or mammoth clover is used for the same purpose.

Relation Between Number of Seeds Sown and Final Stand

(After Piper)

Name of Plant	Average Rate of Seeding to the Acre. Pounds	Number of Seeds to the Pound	Number of Seeds to the Square Foot	Average Number of Plants to the Square Foot for a Perfect Stand
Red clover	10	250,000	60	15
Crimson clover	15	130,000	45	15
Alsike clover	8	700,000	130	15
Alfalfa	20	200,000	93	15
Sweet clover	25	235,000	140	7
Timothy	15	1,100,000	350	90
Kentucky blue-grass	25	2,400,000	1400	130
Orchard-grass	20	4,500,000	210	90
Brome-grass	20	137,000	65	90
Redtop	10	4,000,000	930	140
Meadow fescue	20	250,000	115	90
Italian rye-grass	30	270,000	215	90
Perennial rye-grass	30	270,000	215	90
Tall rye-grass	40	150,000	140	90

The use to be made of the crop influences the amount of seed to sow. If red, mammoth, or crimson clover is to be grown for seed or for soil-improvement purposes, about twelve pounds per acre should be used. About twelve pounds of red or mammoth clover seed should be sown, if the crop is to be used for pasture only. When mammoth or red clover is

sown for hay in combination with other grasses, about seven pounds of seed per acre will usually suffice.

Fertilizing the Clover Crop.—As a general rule it is not necessary to fertilize the clover crop. However, there may be conditions that make it advisable to top-dress lightly with well-rotted barnyard manure. There may be instances in which an application of potash or of phosphoric acid is necessary to successful production. The treatment or management of a clover crop determines in large measure whether or not subsequent clover crops require fertilization.

Job 10. Caring for Clover; Pasturing; Cultivating

Conditions Usually Found.—(1) Many times clover is not given proper treatment. (2) Sometimes the crop is removed from the soil when it should be left. (3) Sometimes it is pastured too closely. (4) It is not customary to cultivate the soil after the clover seed has been sown.

Aims.—(1) Farmers should learn how to care for the clover crop. (2) They should form the habit of practising approved methods of treatment of clover.

Problems for Study and Discussion.—(1) What is the common practice with reference to clipping clover after the nurse crop has been removed?

2. What is the common management in harvesting both a hay and a seed crop annually?
3. What proportion of the farmers of your region keep their clover pastured closely?
4. What can be said in favor of leaving the clover seed crop on the ground?
5. Why do some farmers cut the first crop and leave it on the ground?
6. Get opinions of farmers regarding the top-dressing of clover with manure.
7. What classes of livestock are capable of doing greatest injury to clover by cropping it too closely?
8. Under what conditions should clover be top-dressed with commercial fertilizers? With lime?

Caring for Clover Crops.—After clover seed has been sown there is no attention given it as a rule until it is either used for pasture or cut for hay the following year, except that sometimes it and the weeds are clipped back after the nurse crop has been removed in the summer. The clippings serve as a mulch to conserve the moisture for the growing plants. The removal of the weeds permits the clover to get the full benefit of the sunshine and the moisture.

If the soil is thin, it is profitable to apply barnyard manure or commercial phosphoric acid and potash. The application should be made to the preceding grain crop, or to the clover at the time it is sown, if it is seeded openly.

Pasturing and Clipping.—If the chief use to be made of the clover crop is soil improvement, little if any of the herbage should be removed by pasturing it or by cutting it for hay or seed.

Under favorable conditions it may not injure the clover to pasture it lightly early in the autumn after the nurse crop has been harvested (Fig. 131). Care must be taken to insure that the clover is not cropped so

closely as to leave the crowns of the plants unduly exposed to the rigors of winter.

The full benefits that may be derived from a clover crop will not be realized if the clover is kept cropped or cut closely. Too often the first crop is cut for hay, the second for seed and the aftermath pastured heavily. This severe treatment not only deprives the soil of the vegetable matter which the clover should supply, but it prevents the vigorous development of the root system of the plants and thereby greatly lessens the activities of the nitrifying bacteria. Such treatment of the clover crop not only will prevent improvement of the soil but will probably produce the opposite effect. It removes fertility from the land without the compensation of organic matter and nitrogen added to the soil.

Draining the Soil.—The soil seeded to clover should be kept clear of free water by adequate drainage. If the soil is kept more or less filled

FIG. 131.—Pigs in clover. Their thrifty appearance proves how well the pasture balances their grain ration. (J. C. Allen.)

with water, the air cannot circulate through it properly. The nitrifying bacteria favorable to clover cannot thrive in a poorly aërated soil. Without the proper functioning of these bacteria, the clover plant will not grow satisfactorily.

Keeping out Weeds.—If they are permitted to grow unmolested, weeds rob clover of plant food, moisture and sunlight. Clean culture of preceding grain crops and the clipping of weeds in the clover are perhaps the most effective means of controlling the weeds.

Job 11. Controlling Enemies

Conditions Usually Found.—(1) While there are many insects that injure clover, there are but few that do serious injury. (2) There are a few fungous diseases that sometimes injure clovers seriously.

Aims.—(1) Students should study the diseases and insects that are enemies to clover. (2) They should learn how to control these enemies effectively.

Problems for Study and Discussion.—(1) What are the diseases that seriously injure clover crops in your region?
2. What insects are seriously harmful to clover?
3. How are these harmful diseases controlled?
4. How may these injurious insects be controlled?
5. What burrowing animals injure clover crops in your region?
6. What control methods have been found effective against these animals?
7. What means have been devised for preventing the appearance, in a menacing degree, of insects and diseases injurious to clovers?

Activities.—Collect specimens of insects and diseases and their work for study.

Insect Enemies of Clover.—Clover is injured more or less by numerous insects. Nearly one hundred different insects injure clover in some manner. Only a very few, however, do sufficient damage to threaten the success of the crops. If proper control measures are used even these worst enemies can be prevented from doing serious injury.

The insects that most commonly threaten injury to the clover crop are the clover-seed midge, the clover-leaf weevil, and the clover-root borer.

The clover-seed midge infests the flower of the plant, where it lays its eggs. The grubs feed upon the tender seed and may be so numerous as to destroy the seed crop entirely. Even though the seed crop may not be destroyed, it may be injured sufficiently to make it unprofitable. The practical control measure to be used against this insect is the cutting of the hay crop before the larvæ have developed. If the insects are thus prevented from laying their eggs on the first crop, the second or seed crop will have matured before a new brood of larvæ is hatched.

Root borers do greatest damage the second year of the clover crop. At this stage in the life of the plant the roots have become large enough to provide a harboring place for the larvæ of the borer. These larvæ bore their way into the clover roots and feed upon them, and in this manner sap the nourishment of the clover plant. If the clover crop becomes so thoroughly infested with this insect as to render the crop unprofitable, the land should be plowed as soon as the hay crop of the second year has been harvested.

Leaf weevils feed upon the tender foliage of the clover plant in the early spring. If the crop is given proper treatment so that the plants remain vigorous and thrifty, new growth occurs so rapidly that the leaf weevils do little injury.

Diseases.—Clovers may suffer injury from fungous diseases. These injuries may be kept negligible by rotation of crops and by providing an abundance of food for the clover plant. If the clover plant is kept in a healthy and vigorous condition, the injury from fungous diseases is not serious. The few diseases that should be guarded against are root rot, rust, stem rot, leaf spot, and anthracnose.

Noxious weeds may become serious enemies of the clovers. Buck-

horn and wild mustard should be guarded against. The presence of seed from these and other weeds in clover seed is objectionable.

Dodder in clover is highly objectionable because of its parasitic nature. It twines itself around the clover plant (Fig. 132). Eventually the dodder attaches itself to and feeds upon the clover. When clover

FIG. 132.—Dodder is a thread-like parasite which sometimes ruins the clover crop. Watch for dodder seed before planting clover. (J. C. Allen.)

seed is cleaned preparatory to seeding, great care should be taken to eliminate all dodder seed.

Job 12. Harvesting and Curing Hay

Conditions Usually Found.—(1) Successful harvesting and curing of clover hay is determined largely by the stage of maturity at cutting and by weather conditions.

(2) The seasonal labor load on the farm and the supply of available workers are important factors with which to reckon. (3) Facilities for storing hay are important. (4) In some instances the crop is not harvested but is left on the field to increase the protein and humus content of the soil.

Aim.—Students should know and learn to practice the best known methods of harvesting and curing clover hay.

Problems for Study and Discussion.—(1) At what stage of maturity should clover be cut for hay?

2. What preparation should the farmer make for accomplishing the harvesting with the utmost dispatch?
3. State the principles involved in curing hay in the field.
4. What problems are involved in the curing process after hay is stored?
5. State the problems involved in curing hay in the field.
6. Describe the processes involved in handling hay in the field.

Activities.—Examine harvesting machinery and adjustments.

FIG. 133.—Clover stacks protected from the weather by stack covers to shed rain. Such wooden covers may be used for several years. (J. C. Allen.)

Harvesting Clover Hay.—The value of clover hay is determined in large measure by the harvesting process. It is possible to render the hay objectionable and even injurious to livestock by improper management of the harvesting.

Clover should be cut for hay at the time when the majority of the blossoms are slightly past full bloom. It is advisable to cut clover early in the morning as soon as the dew is off so as to prevent the shattering of the leaves. The principal part of the feed value of clover hay is in the leaves. It is important that they be retained on the stems and that they do not become brittle. When clover hay is so dry that the leaves shatter and break into bits, the best part of the hay is lost and the part that is left is not palatable.

Practically all clover hay is cut with a mower drawn by horses or driven by a motor. In rare instances a mower drawn by one horse is used. A scythe is sometimes used to cut small patches on a rough surface.

After the hay has been cured it is stored in the mow or is piled in stacks or ricks either in the open or under sheds (Fig. 133). Care must be exercised to insure that the hay is not damp or too green when stored. If either damp or too green when stored, the hay is in danger of over-heating. One of two injuries may result from over-heating—either the

FIG. 134.—Red-clover-project student using side-delivery rake, putting clover hay into windrows so that it may be handled with the automatic loader seen in the distance.

hay may catch fire by spontaneous combustion or it may become moldy and unpalatable.

Clover hay should be stored under cover whenever possible because it has but little power to shed rain. If the hay is stored in the open, the top of the stack should be covered with grass hay or with canvas and the covering should extend well down the sides.

Curing Clover Hay.—The object in curing clover hay is the reduction of the moisture content to the point where the hay will not spoil

and yet will retain sufficient moisture to prevent the leaves from shattering or breaking. The curing process should be such as to preserve the aroma of the mown hay, the bright green color and maximum feeding value.

It requires experience to qualify one to determine when clover hay is cured sufficiently to be stored. A fairly reliable test can be made by taking a representative sampling of the hay and twisting it by hand. If the stems and leaves do not break and if no moisture exudes, it is highly probable that the hay is ready to be stored.

FIG. 135.—When clover is to be loaded by hand it may be "bunched" in the field to hasten the loading of wagon.

Clover hay requires some shading for proper curing. As a rule it is advisable to cure it in cocks rather than in the windrow. Figure 134 shows the use of a side-delivery rake and loader taking up the windrows. Piling it in cocks provides the necessary shading and promotes the heating or sweating process, and at the same time prevents undue fermentation (Fig. 135). Curing clover hay in the windrow for some time is not recommended. Rapid curing in the swath may not cause undue bleaching. The hay may then be raked into windrows before hauling.

Job 13. Harvesting Seed and Threshing

Conditions Usually Found.—(1) Harvesting clover seed successfully is dependent in large degree upon weather conditions. (2) The seed crop of some clovers is obtained from the second cutting, the first cutting having been harvested for hay or having been left in the swath for mulch and fertilizer.

Aim.—Farmers should learn how to harvest and thresh clover seed with a minimum loss of seed.

Problems for Study and Discussion.—(1) At what stage of maturity should clover be cut for seed?

2. In what condition must the clover be for threshing?
3. Compare red, alsike and crimson clovers in this respect.
4. What processes are employed in conditioning clover for threshing?
5. What varieties of clover will yield both a hay crop and a seed crop?
6. Ask farmers if it is good farm practice to harvest both a hay crop and a seed crop of clover.
7. What yields of seed may be expected from different clovers?

Activities.—Visit places where seed is being harvested and threshed and report on methods. Get samples from each place and compare them for weed seeds and other impurities.

Cutting Clover for Seed at the Best Time.—The general rule to follow with reference to harvesting seed is to cut it as soon as the heads have browned and the seed has hardened beyond the soft dough stage, and to hull it as soon as the heads and straw have become thoroughly dry.

In general it may be said that the second crop is the one to cut for seed. This rule applies especially to red clover. The first crop of alsike usually produces a higher yield of seed than does the second crop.

The first clover crop may be cut for hay or it may be clipped and left lying on the ground provided the growth is not too heavy. The first crop may be pastured provided the stock are not permitted to remain on it too late in the season and are not allowed to crop it too closely when the season is dry. This method of management is especially applicable to red, mammoth and white clovers. The first crop of alsike is usually a seed crop. Crimson clover is used but little for hay. It is often harvested for the seed crop early in the season.

Cutting by Good Methods.—Clover cut for seed should be handled as little as possible. If care in this regard is not exercised a great deal of the seed will be lost by shattering. The clover may be cut with a mower as for hay. When this method is used it is necessary to rake it into windrows. Unless it is raked before late in the forenoon, or while slightly damp, the seed will shatter badly. The cutting may be done with a mower with a side-sweep rake attachment which bunches the straw. A grain binder is used in some instances. When the binder is used the straw may be bound loosely into bundles or it may be allowed to be delivered loose in a continuous row.

Method of Hulling.—The seed may be separated by means of a machine constructed especially for the purpose. Such a machine is called a huller. A grain threshing machine with a special attachment for clover may be used. The former method is more commonly employed than the latter.

The clover may be carried to the huller direct from the field. This

practice is common. If the clover is stored in stacks or in the barn so that the hulling may be deferred until the busy season has passed, the labor is increased greatly over that required for threshing direct from the field and there is greater loss of seed from shattering.

Job 14. Using the Crop for Feed and Manure

Conditions Usually Found.—(1) Clover is used for pasture for all classes of livestock. (2) Clover hay is used for feed for horses, cattle, and sheep. (3) Farmers often make the mistake of pasturing their clover crops closely, to the detriment of the soil. (4) Many times they sell the hay when it could more profitably be fed to livestock.

Aims.—(1) The value of returning clover crops to the soil, either through livestock or by plowing under the plant, should be learned by clover growers. (2) They should learn how to grow and manage clover crops in a manner that will maintain or increase the fertility of their soil. (3) They should become practised in the best methods of using clover as a feed for livestock.

Problems for Study and Discussion.—(1) What proportion of farmers in your region sell clover hay?

2. Describe briefly the methods of feeding clover hay as practised by successful farmers.
3. What kinds of racks have been found most satisfactory for use in feeding clover hay to loose cattle during the winter?
4. What kinds of racks have been found most satisfactory for use in feeding clover hay to loose sheep during the winter?
5. What use may be made of salt in feeding clover hay to livestock?
6. What losses may occur in feeding clover hay?
7. How can these losses be reduced to the minimum?
8. Under what conditions is clover hay a satisfactory feed for horses?
9. For what classes of livestock is clover hay best suited?
10. For what classes of livestock is clover pasture best suited?
11. Point out precautions that should be observed in pasturing clover.
12. Which of the clovers are used for soil improvement?
13. What are the benefits of green manure from clover?

Activities.—Make working drawings of each of the kinds of rack mentioned. Make lists of materials for each.

Feeding Clover Hay.—When properly cured and stored, clover hay is an excellent feed for farm animals. It is often sown in combination with other grasses to diversify somewhat the roughage ration and in some instances to increase the hay yield. Clover hay is in itself almost a balanced ration. It is not used exclusive of other feeds for animals under some conditions, because they cannot consume a sufficient bulk of it to satisfy their needs in full. Good clover hay without other feeds provides in a satisfactory way for a considerable period of time a balanced ration for non-producing mature sheep, cattle, goats, horses, and mules. It may also suffice up to weaning time for the young of these same classes of farm animals. But for work-horses and mules, for milk cows and brood sows, for ewes with lambs, or for horses, mules, or cattle with young animals at their sides, the clover hay must be supplemented with concentrates.

Clover hay is not a superior hay for work-horses. It has the effect of producing too much fat. If fed to work-horses when it is too dry it produces "heaves." Timothy is superior to clover for work-horses and mules.

Clover as Pasture.—Clover is an excellent pasture for young farm animals. It provides the protein necessary for building the frame of the growing animal. Clover pasture provides much of the protein required by laying hens and by cows in milk. In regions where clover can be grown successfully, a great deal of the protein for farm animals can be furnished more cheaply in clover pasture or hay than in the form of commercial concentrates.

Clover is frequently grown in combination with other grasses for pasture. This practice is recommended in case a variety of pasture is required for different classes of animals. Practically every standard grass seed mixture used contains clover seed of some variety in various amounts.

Precautions must be taken to prevent bloating of animals when they are first turned onto clover pasture. The animals should be allowed to remain on the pasture only a few hours when first turned into the field. The grazing period can be increased gradually for three or four days by which time the animals should suffer no ill effect from remaining on the pasture permanently.

Job 15. Baling and Marketing

Conditions Usually Found.—(1) Types of bales vary somewhat for different regions. (2) Clover hay is more difficult to handle than grass hay. (3) Clean hay of uniform grade sells more readily than hay that falls below these standards. (4) Too often clover hay is not prepared for market in the way it should be. (5) Methods of marketing hay are not so advantageous to the farmer in many instances as they could be.

Aims.—(1) Students should learn the standard market requirements for different grades of clover hay. (2) They should learn how to prepare clover hay for market. (3) They should be conversant with the most approved methods of marketing clover hay.

Problems for Study and Discussion.—(1) Find out from inquiry among the farmers of your region how much clover hay is sold by them each year.

2. Ask the farmers of your region for information concerning their best clover-hay markets.
3. What grades of clover hay are most common on the markets of your state?
4. Give the locations of the principal clover-hay markets in the United States.
5. Is it profitable management to sell clover hay from the farms in your region? Give reasons for your answer.
6. What prices for clover hay are most common in your region?
7. What methods are most often used by farmers in your region in marketing clover hay?
8. Make a table of market prices for each month for clover hay in your state for the last five years.
9. What general rule would you advise farmers to follow with reference to holding their clover hay for fall, winter, or spring market?

10. In what form is clover hay of your region usually placed on the market?
11. What are the standards for sizes of bales and for quality of clover hay in the United States?
12. Obtain market prices for clover seed.
13. Calculate income per acre for hay and for seed.
14. Study market requirements regarding purity of seed.

Activities.—(1) Weigh bales of clover. (2) Calculate weights of seed per measured bushel.

Sizes and Weights of Bales of Clover Hay.—Clover hay that is shipped by rail is compressed into bales. These bales vary in size from 100 to 200 pounds, the former size being more common than the latter. The hay is baled for shipment because it is more conveniently and expeditiously handled in this than in loose form and because the wastage is much less when shipped in bales than when handled in bulk. Baled hay occupies less than one-third the space required for loose hay.

Baling Hay.—The common dimensions of a bale of hay are 16 by 18 by 40 inches. The average weight per bale is about 150 pounds.

Clover hay should be cured thoroughly before it is baled. It should not be allowed to become dry and brittle in the curing and storing process, because this condition not only lowers the quality of the hay, but it is highly conducive to loss of leaves and of the more palatable parts of stems.

Hay presses are operated by horse power or by steam or gasoline engines. The farm tractor is frequently used to supply the motive power for baling machines.

The hay is compressed into a rectangular bale and is securely bound by wire while under compression.

Grades of Clover Hay.—The grades of clover hay officially recognized by the National Hay Association are No. 1 and No. 2 clover hay; light No. 1 and No. 2 clover-mixed hay; and grades of hay of very low quality.

Marketing Clover Hay.—Hay is sometimes sold by the load direct from the field. Frequently the weight is estimated, if wagon scales are not conveniently at hand.

If the hay is to be shipped a considerable distance, it is baled for shipment. Usually it is sold to a local dealer who purchases from several producers and ships by the carload.

Coöperative marketing has not been developed by farmers for clover hay to as great an extent as for some other farm products.

As a general rule it is more profitable to market clover hay by feeding it to livestock than to dispose of it as a cash crop. When hay is sold on the market, the organic matter is not available for return to the soil.

Marketing Clover Seed.—Prices for clover seed are usually higher at seeding time than at harvest time. For this reason seed is sometimes

held when conditions are favorable. The seed crop should be recleaned before offering it for sale. Standard seed and tested seed bring best prices. If often pays to advertise seed, and to arrange through county agricultural agents or Farm Bureau organizations for selling seed direct to planters.

Things to Make at Home.—Sharpen mower blades; adjust and oil machines; make racks for feeding which will save leaves.

ALFALFA ENTERPRISE

By Ray I. Throckmorton, B.S., M.S.

Head of Department of Agronomy, Kansas State Agriculture College

Analysis Into Jobs.—The following jobs cover all the principal points in alfalfa production. References are to Farmers' Bulletins. See also *Alfalfa in the United States and Canada* by Stewart.

1. Determining possibilities with alfalfa, and choosing the field. 1021, 1283.
2. Preparing the soil. 1021, 1283.
3. Liming the soil. 921.
4. Inoculating seed or soil. 1021, 1283.
5. Fertilizing alfalfa. 1021, 1283.
6. Selecting varieties and good seed. 1467.
7. Seeding alfalfa. 1021, 1283.
8. Controlling diseases, insects and rodents. 636, 944, 982, 1094.
9. Cultivating and controlling weeds. 1283.
10. Harvesting for hay and for seed. 1525. U. S. D. A. Bull. 1424.
11. Using and marketing the crop. 1229, 1265.
12. Irrigating alfalfa. 865.
13. Summarizing the records. 511, 572, 782, 1182.

Job 1. Determining Possibilities with Alfalfa and Choosing the Field

Conditions Usually Found.—(1) Most farmers in certain sections would not be without alfalfa. (2) A few farmers in most sections are successful with this crop. (3) Many farmers in certain sections believe that alfalfa is extremely difficult to grow. (4) Farmers who are familiar with alfalfa are enthusiastic about it. (5) Practically every farm contains some land that will grow alfalfa successfully.

Aims.—(1) All factors involved in the economic growing of alfalfa should be thoroughly understood before undertaking it. (2) The omission of one essential may result in failure. (3) The pupil should learn to recognize land that is adapted to alfalfa.

Problems for Study and Discussion.—(1) Where are the important alfalfa regions?

2. What are the climatic requirements for alfalfa?
3. What are the soil requirements for alfalfa?
4. What yields of hay may be expected?
5. How many cuttings per year of alfalfa are secured?
6. What is the feeding value of alfalfa hay?
7. How does the price of alfalfa hay compare with that of other forage crops?
8. What is the influence of alfalfa on the soil?
9. What is the place of alfalfa in the rotation?
10. How long are alfalfa stands maintained?
11. Why is alfalfa not more generally grown?
12. What soils in your neighborhood are best adapted to alfalfa?
13. Why is good drainage necessary?

14. What should be the acreage of alfalfa on your home farm?
15. What is alkali soil?
16. Ask growers to compare soil requirements for corn and for alfalfa.

Activities.—Make a table or chart comparing the feeding value of a ton of alfalfa with clover and other forms of hay. Compare also the yields per acre.

Alfalfa Regions.—Most of the alfalfa produced in the United States is grown west of the 95th meridian. Nebraska, Kansas and California are the three leading states in production, but the crop is an important one in all of the western states. There is no state in the Union which does not grow alfalfa to some extent. No other known perennial forage crop will produce as much high-protein feed under good natural conditions and under irrigation. The growing of alfalfa is closely associated with the agricultural development of Western America.

To Grow Alfalfa

Select medium soil
Secure good drainage
Inoculate seed
Apply plenty of lime
Prepare land well
Practise bare fallow
Seed August 15 to Sept. 15
Use clean seed
Sow 30 lbs. per acre

Climatic Requirements.—Alfalfa will thrive under extreme summer temperatures if humidity is low, but high temperatures combined with medium or high humidity are likely to be distinctly injurious. Alfalfa production has been most successful in those regions having a semi-arid to subhumid climate (Fig. 136). Its production in regions of high rainfall is usually successful only where soil conditions are extremely favorable.

Adapted varieties of alfalfa will stand temperatures as low as 40 degrees F., or even lower if the plants are protected by snow and the moisture content of the soil is not too high. Young alfalfa plants are frequently injured by low temperatures in the fall or early spring, but temperatures throughout the United States do not generally become too low for alfalfa production.

Soil Requirements.—A deep, well-drained soil is essential for alfalfa. Low, flat areas with the water table near the surface are not satisfactory for this crop unless they are tile-drained. Deep soils are especially

suitable because of the great root development of the plants. Alfalfa will not thrive on acid soils or on soils heavily charged with alkali.

Lime must be present, (Fig. 137), and if the soil is naturally deficient in lime this element must be supplied before seeding the crop. A good potash supply is also essential.

Value of the Crop.—The yields of cured hay range from one to four tons per acre in dry regions without irrigation and from six to eight tons when the crop is irrigated. In more humid regions yields of four to six tons per acre are not uncommon. Alfalfa may be expected to yield from two to three times as much hay per acre as red clover or timothy.

FIG. 136.—In Kansas alfalfa finds a very favorable climate. H. W. Schmitz and his class in vocational agriculture studying the stage of curing in one of their alfalfa projects. (Manhattan, Kansas High School.)

The number of cuttings varies from two to five depending upon the length of the season, the moisture supply and the condition of the soil. Three cuttings annually is a good average for most sections.

There is no other forage crop that compares in feeding value with alfalfa hay. A ton of cured alfalfa hay is almost equal in feeding value to a ton of wheat bran. For dairy cows and growing livestock its feeding value is nearly double that of mixed clover and timothy hay and about three or four times that of timothy hay. Alfalfa also commands a higher price on the market, especially in dairy regions.

Alfalfa has few superiors as a soil-improvement crop. While it occupies the land the soil will not erode. The extensive root system, parts that shatter off, and the old stubble leave large quantities of organic matter

in the soil. The crop, because of its deep root system, may transfer plant nutrients from the lower soil to the roots near the surface or to the stems, from which they will later become available for more shallow-rooted crops. Through the aid of bacteria the plant can obtain nitrogen from the air, and as the plant residue and the nodules decay in the soil the nitrogen becomes available for crops that come late in the rotation.

At the Kansas Station the growing of alfalfa in rotation with corn and wheat resulted in an average increase of 11.2 bushels of corn per acre over a period of fifteen years, and of 3.5 bushels of wheat per acre over the same

FIG. 137.—Student not only conducted a successful alfalfa project, but he also ran a trial with it, which proved the value of liming. Left, limed; right not limed. (Winfield, Kansas, High School.)

period of time as compared with the continuous production of each of these grain crops. (Figs. 138 and 139.)

Rotation.—In many of the alfalfa-growing regions the crop is not considered as a part of the crop rotation on the farm. These growers seed a field to alfalfa and leave the crop on the land as long as a profitable return can be secured. Under very favorable conditions stands of alfalfa have been maintained for a period of more than thirty years. Such conditions are usually found in the sub-humid regions and where the crop is grown under irrigation. The best use can be made of alfalfa in the rotation by leaving it on the land for a period of not more than four or five years, and in the more humid sections it is frequently advisable to leave the crop for not more than two years. Under such conditions alfalfa may be handled in the same manner as red clover.

Alfalfa can be used to best advantage under most conditions by placing it in the rotation after a small grain crop. The crops which follow alfalfa should be those which use a large quantity of nitrogen. The best crops

FIG. 138.—Increasing the yields of corn two and one-half times by growing alfalfa in the rotation. Left, corn grown in rotation with alfalfa. Right, corn grown continuously. (Kan. Agr. Exp. Sta.)

FIG. 139.—Producing higher yields of better wheat by having alfalfa in the rotation. Plot at left after four years of alfalfa. Plot at right fifth year continuous wheat. (Kan. Agr. Exp. Sta.)

for this purpose will vary with soil and climatic conditions. Throughout central and eastern United States where corn is generally grown this crop may follow alfalfa to good advantage. Farther west, where the rainfall is lighter, more drouth-resistant crops, such as kafir, should be used.

Oats and barley are the most successful small grains to follow alfalfa. Other crops which may be used include potatoes, sugar-beets, and cotton.

Many farmers believe that alfalfa is extremely difficult to grow and that is requires some special knowledge or gift to produce the crop successfully. If proper attention is given the essential requirements of the crop, failure will be no more common than with crops such as red clover.

Locating the Field.—Since practically every farm contains some land that will grow alfalfa, the first problem is to determine what portion of the farm is most suitable for the crop. Shallow soils or those having rock near the surface should be avoided because they will not permit good root development of the plants. Soils having an impervious subsoil are not satisfactory for the same reason and because such soils are usually poorly drained. Sandy subsoils are not retentive of moisture and the crop yields are usually light and the stand of short duration. On extremely sandy and on heavy clay soils it is usually difficult to obtain and maintain a stand. Soils that have poor surface drainage and those that have a water-table near the surface are not suitable. Soils having a sandy-loam, loam, or silt-loam surface soil and a clay-loam to friable-clay subsoil have the best physical condition for alfalfa production.

One of the easiest and most satisfactory methods of determining the physical conditions of the soil is to make frequent borings to a depth of three or four feet with a soil auger. Each six inch layer of soil should be examined carefully for desirable characteristics. Poor surface drainage can be detected by observing if the land is subject to overflow from an adjacent stream, if it receives surface water from adjoining land, or if it is so level that water will not drain off readily. A shallow water-table may readily be detected by making holes to a depth of three or four feet with a post-hole digger and then examining them a few days later to learn if they have become partly filled with water.

Irrigated Fields.—Most of the alfalfa grown in the western half of the United States is produced under irrigation. In this region it is necessary to consider the possibilities of irrigating the crop. The foregoing soil characteristics apply to these areas, but in addition the water supply should be considered. Under most irrigated conditions the amount of water necessary for the profitable production of the crop is a quantity which will permit the equivalent of at least one application for each cutting of hay.

Alkali soils, or those having an excess quantity of soluble salts, are quite common in this region, especially where the soils are heavy or poorly drained; therefore, the surface soil should be examined when dry for a white incrustation. This incrustation indicates the presence of alkali and should be taken as a warning that it is safest to have an expert determine

the quantity of alkali before the field is seeded. Although mature alfalfa plants are more resistant to alkali than are most other cultivated crops, the young plants are rather susceptible to injury.

Growing without Rotation.—Continuous production refers to the growing of alfalfa for many years without an attempt to change the land to some other crop. In the major alfalfa-growing sections there are many hilly areas that are very subject to erosion but will grow alfalfa successfully. On these hilly lands and in those regions where it is very difficult to obtain a stand it is usually best to leave the crop on the field until it becomes unprofitable. Under other conditions the crop should be grown in a rotation.

The acreage of alfalfa will vary greatly with farming practices. Where the crop can be grown to good advantage, one acre for each milk cow and one-fourth acre for each calf with sufficient quantity for swine and poultry pasture will meet the demands on a general farm. A larger acreage will be necessary when a large number of beef cattle are produced. When alfalfa is grown as a cash crop the acreage is frequently very large, and is limited only by the amount of suitable land and the available labor supply.

Job 2. Preparing the Soil

Conditions Usually Found.—(1) Failure to obtain a stand of alfalfa is frequently due to poorly prepared soil. (2) Many farmers plow too deep and have the soil too loose and open at seeding time. (3) Farmers who understand the preparation of the soil seldom fail to obtain a stand of alfalfa.

Aims.—(1) Students should understand the importance of a well prepared seed bed. (2) They should know how to obtain such a seed bed under different conditions.

Problems for Study and Discussion.—(1) Why should land usually be plowed shallow for alfalfa?

2. What are the advantages of plowing early?
3. To what extent should the land be cultivated after plowing?
4. When is it not advisable to plow?
5. Why must the alfalfa seed bed be fine and firm?
6. What is the fallow system?
7. Under what conditions should the fallow be used?
8. How should the soil be prepared for alfalfa in your neighborhood?

Activities.—Make a trial with plots to compare the effects of three harrowings one week apart with one harrowing of the soil before planting. Compare also a settled seed bed with one recently plowed at seeding time.

Seed-Bed Requirements.—Alfalfa seed is very small, and for this reason its germination and the early growth of seedlings is greatly influenced by the condition of the soil. The ground should be fine but quite firm except to a depth of about one-half inch. There should be an abundance of moisture and available plant nutrients in the soil at the time of seeding because the young plants are weak feeders. When seed are planted in loose, open soil, germination is not uniform, and many of the seedlings

may die because air circulating freely through the soil comes in contact with the small roots, dries them up, and finally kills them. Seed placed in a firm, damp soil comes in close contact with the soil particles, absorb moisture readily, and germinate quickly; and the roots are in contact with moist soil as soon as they develop. The methods of obtaining these conditions vary with the rotation, the nature of the soil, climatic conditions and the time of seeding.

Plowing.—Under most conditions it is advisable to plow the soil in preparing for alfalfa, although there are conditions where it is not necessary. Since considerable time is required to liberate nutrients, store moisture, and form a good seed bed, the plowing should be done as long as possible before the time of seeding. Another reason for early plowing is that it offers a better opportunity to destroy weeds before seeding.

The best time to seed alfalfa under average conditions in the eastern part of the Great Plains and farther east is in the late summer or early fall. A very successful method under these conditions is to plow the land to a depth of about three inches immediately after harvesting a small grain crop. Disking or harrowing immediately after plowing will bring the soil in closer contact with the stubble and hasten its decay. Additional cultivation will be necessary to destroy weeds and volunteer grain but such cultivating should be shallow and frequent enough to destroy the weeds while they are very small. A heavy weed growth will destroy all of the benefits to be derived from the early plowing.

Where spring seeding is practised on land that was in a small-grain or grass crop the previous year, fall plowing is preferable. The soil may be left in a rough condition until early spring, when harrowing and disking are necessary. Deep disking in spring should be avoided if possible because it leaves the soil too open.

Disking.—Soil that is free from weeds and land that produced corn or some other row crop the previous year may be prepared for spring seeding of alfalfa by disking the soil in the early spring. This method is especially adapted to those soils that are naturally loose and open. In some localities it is a common practice to disk oat- or wheat-stubble land in preparation for fall seeding. This practice is not to be recommended, and the labor required to destroy the volunteer grain is usually as great as would be required to plow the land and prepare it in the usual manner.

Summer fallow consists of keeping the land free of vegetation for one crop year for the purpose of storing moisture or liberating nutrients for the following crop. In the lighter-rainfall regions it is necessary to fallow the land for a year before alfalfa is seeded. Summer-fallowing is also frequently used in humid regions on thin lands that are to be seeded. The chief purpose in this case is the liberation of nutrients. Fallowed

land must be cultivated frequently enough to prevent weed growth but the soil must not be made too fine or it will be subject to erosion by wind.

Firming the Soil.—The most satisfactory type of implement with which to obtain a firm seed bed is the subsoil packer (Fig. 140). A corrugated roller may be used but it does not leave the immediate surface layer as loose as is desirable. Extremely loose soil should be firmed both before and after seeding. There is little danger of having the soil too compact.

FIG. 140.—A firm soil at seeding time is essential. The cultipacker is often used just after seeding to aid in quick germination. (Kan. Agr. Exp. Sta.)

Job 3. Liming the Soil

Conditions Usually Found.—(1) Most of the soils of central and eastern United States are acid. (2) Alfalfa frequently fails because there is not sufficient lime in the soil. (3) Many farmers do not fully appreciate the importance of liming for alfalfa.

Aims.—(1) Students should learn to determine the lime requirements of soil. (2) They should understand the importance of lime for alfalfa production. (3) They should know the methods of using lime.

Problems for Study and Discussion.—(1) What is the meaning of soil acidity?
2. How do soils become acid?
3. What qualitative tests are used in determining soil acidity?
4. Secure samples of soil from your home farm and test them for acidity.
5. Why is alfalfa not adapted to acid soils?
6. To what extent is it necessary to lime for alfalfa in your locality?
7. At what time in the preparation of land for alfalfa should lime be applied?
8. What form of lime do farmers use in your region?
9. Compare the forms of lime in power to correct soil acidity?
10. How much lime should be used per acre on your farm?
11. Why should lime not be plowed under?
12. Why must lime be incorporated with the soil?

Activities.—(1) Make a test of soil for acid and for lime to determine quantity of lime needed. (2) Collect samples of lime, label each and give its price.

Soil Acidity.—When soils are deficient in strong active bases, such as calcium, they are said to be acid. A high percentage of the upland soils and many of the bottom land soils of the eastern half of the United States are acid. Acid soils are the result of three causes: (1) the lime being leached out by percolating water; (2) the removal of other bases by plants; (3) the long continued use of such commercial fertilizers as ammonium sulfate. Contrary to popular opinion, the plowing under of green-manure crops and the application of stable manure do not cause permanent acidity. Acid soils very seldom occur in regions of light rainfall.

Testing for Acidity.—The zinc-sulfide test is one of the best for laboratory use. It consists of mixing about 10 grams of the soil to be tested with a small quantity of a mixture of neutral barium chloride and zinc sulfide. After adding 100 cc. of water, the mixture is heated to boiling. After boiling has continued for two minutes a strip of lead acetate paper is placed over the mouth of the flask for two minutes while the boiling continues. If the soil is acid, the paper will turn dark on the underside. The degree of acidity is measured by the intensity of the color.

The "Soilte," and potassium thyo-cyanate or "Rich-or-Poor" tests are well adapted to field conditions if they are properly used. The former is a test for alkalinity as well as acidity. The latter is a test for active iron, the presence of which indicates a deficiency of lime. When all factors are considered the potassium thyo-cyanate method is perhaps the best for field conditions, as no heating is required. (See corn enterprise.)

Sample for acidity tests should be obtained from the surface four inches of soil.

Alfalfa and Acid Soils.—Alfalfa is not adapted to acid soils and the crop can not be grown successfully on such soils. When lime is lacking the plants become a yellowish green color, the leaves are small and the yield is very light. The organisms which live in the nodules on the roots of the plants require lime for their development. If the soil is acid these organisms will not be present and the plant can not obtain its nitrogen from the air. A ton of alfalfa hay contains about fifty pounds of calcium, far more than any other general farm crop. For this reason calcium, which is supplied in the form of lime, is essential as a nutrient. In addition to these factors the crop is not adapted to acid soils.

Forms of Lime.—The more common forms of lime used for agricultural purposes are burned lime (CaO), hydrated lime ($Ca(OH)_2$), crushed limestone ($CaCO_3$), and marl ($CaCO_3$). The form to use is determined largely by the relative costs of the calcium.

Burned lime or quicklime contains about twice as much calcium as crushed limestone. Because of its caustic properties it is somewhat dis-

agreeable to apply and for this reason is usually placed in large piles and slacked before being put on the soil.

Hydrated lime contains about one and one-half times as much calcium as crushed limestone. It is easy to apply and is used quite extensively in those localities where limestone is not abundant.

Crushed limestone is the form of lime most generally used. The stone should be pulverized sufficiently fine for all of it to pass a ten-mesh screen and for 40 per cent to pass through a hundred-mesh screen. This is usually the cheapest form of lime and it is easily applied.

The use of marl for correcting soil acidity is limited primarily to those sections where marl beds occur. It is used successfully where it can be obtained at a low cost.

Regardless of the form in which lime is applied to the soil it will quickly change to the carbonate—the same form in which it is found in limestone.

BENEFITS OF LIME

Acts as plant food
Unlocks other plant food
Sweetens sour soils
Helps growth of legumes
Favors helpful bacteria
Aids nitrogen fixation
Improves soil texture
Helps control moisture
Aids decomposition

Applying Lime.—The rate of applying lime will vary with the degree of acidity, the length of the crop rotation, and the fineness, form and purity of lime used. The required amount of crushed limestone varies from about one to four tons per acre but the average application is about two tons. When other forms are used the rate should be reduced in proportion to the relative amount of calcium in the material. About one-half ton of burned lime or three-fourths ton hydrated lime is equivalent to one ton of crushed limestone.

The best method of applying lime is with the lime-spreader (Fig. 141) but a manure-spreader may be used if straw is placed on the slats to keep the lime from sifting through. Burned lime and hydrated lime can be applied with a fertilizer-drill. All forms may be spread from the wagon with a shovel, but it is difficult to get a uniform application by this method.

Lime performs its function in the soil (Fig. 142) by coming in contact with the soil particles. For this reason, it must be thoroughly incorporated with the surface soil. Lime must not be plowed under because it tends to

FIG. 141.—A Missouri lime-spreader constructed by Vocational Agricultural class of Adrian, Missouri. (Morris.)

work downward in the soil and the acidity of the surface soil will not be corrected. Since lime must be incorporated with the soil it cannot, under most conditions, be used successfully on an established stand of alfalfa.

FIG. 142.—Alfalfa will not grow successfully on acid soils but lime will overcome this difficulty. Lime on right, no lime on left. Farm of Frank Nesbitt, Fowler, Ind. (J. C. Allen.)

When to Apply Lime.—When alfalfa is to be seeded in the fall the lime can be applied to best advantage just after plowing the ground. It

can then be worked into the soil by later cultivation. For spring seeding on land that is not to be plowed the lime may be applied during the late winter or early spring and can then be worked in as the land is cultivated. When land is not to be plowed for alfalfa the lime may be applied just after plowing for the previous crop.

Job 4. Inoculating Seed or Soil

Conditions Usually Found.—(1) Many soils do not contain the proper bacteria for alfalfa. (2) Those who are not familiar with inoculating believe it is a difficult process. (3) Many farmers do not appreciate the importance of inoculation.

Aims.—(1) Students should know the importance of inoculation. (2) They should know how to inoculate seed or soil.

Problems for Study and Discussion.—(1) What organism is associated with alfalfa in a symbiotic relationship?

2. Upon what other legumes do the same species of bacteria grow?
3. What relationship exists between the alfalfa plant and its bacteria?
4. If alfalfa is not inoculated where will the plant get its nitrogen?
5. What influence does a lack of inoculation have on soil fertility?
6. How long do these nodules live?
7. Under what conditions is it advisable to inoculate?
8. What methods of inoculation are in use?

Activities.—(1) Carefully dig and examine the roots of growing alfalfa plants for nodules. (2) Inoculate seed by the agglutination method.

Choosing the Bacteria.—The organism which is associated with alfalfa is a strain of *Bacillus radicicola.* The same strain of bacteria is found associated with sweet clover, bur clover and trefoil. Soil from these plants may contain alfalfa bacteria. They attack the roots of the plants in search of food, injure them slightly and a lumpy growth called a *nodule* develops. The organisms are found in these nodules. They obtain their food from the plants, and fix or hold atmospheric nitrogen which in turn is used by the alfalfa. This is called a *symbiotic* relationship or *symbiosis.* The nodules in which the organisms live die and slough off during and at the close of the growing season.

Importance of Inoculation.—The alfalfa secures its nitrogen from the air by the aid of the bacteria if they are present. If they are not present it can not secure its nitrogen in this way and does not make a satisfactory growth. The plants may make a good early growth but as soon as the available nitrogen of the soil is depleted they turn yellow and gradually die. Very few soils contain sufficient nitrogen to maintain a stand for any great length of time if the bacteria are not present. When alfalfa is grown without the proper bacteria the nitrogen content of the soil will be depleted more rapidly than when any other crop is grown.

Presence of Bacteria.—The alfalfa strain of *Bacillus radicicola* is usually present in those soils that have recently produced alfalfa, sweet clover, bur clover or trefoil successfully. In alfalfa regions soils that are subject to occasional overflow usually contain these bacteria.

Soils that have not recently produced alfalfa or any of the other crops which require the same bacteria and acid soils that are poorly drained or are somewhat high in alkaline salts do not contain the bacteria and require inoculation.

There is no practical way of determining whether or not to inoculate for alfalfa unless nodules are found on the roots of the plants. If there is any doubt it is best to inoculate. It is not an expensive practice and may mean the difference between success and failure.

Methods of Inoculation.—There are three common methods of inoculation: (1) The *agglutination method;* (2) the *use of soil* from fields where alfalfa or sweet clover is growing or has been grown successfully; and (3) use of *commercial or artificial cultures* of some form.

1. The agglutination method of inoculation with soil is becoming more common than the soil transfer method. The steps are as follows: (a) Secure about a peck of soil containing the organisms. (b) Put half of this soil in a tub of water and stir it thoroughly until all of the soil is dispersed. (c) After two minutes of settling pour out the muddy water into another vessel and add two tablespoons of liquid glue for each gallon of water. (d) Pour the seed out on a smooth floor, sprinkle with the muddy water, stir until all of the seeds are wet and spread it in a shady place to dry. (e) Sift the other half of the soil to remove trash and clods and sprinkle it over the wet seed, stirring so that it will be thoroughly mixed. As soon as the seed dries it is ready to sow. Seed treated in this manner should be sowed at once if possible, but may be kept for a week or more in the shade without injury.

INOCULATING LEGUMES

1 peck soil from crop
Mix ½ peck in tub of water
Drain off water for use
Add 1 ounce liquid glue
Wet all seed needed
Sift rest of soil on seed
Spread in shade to dry
Sow within three weeks

2. There are two common ways of using the soil method. The surface inch of soil in a field containing the organisms may be scraped off and discarded and the next four or five inches taken for inoculating purposes. This soil may then be broadcasted without drying over the field to be

seeded. From 300 to 400 pounds of soil per acre are required to produce good inoculation. The field should be harrowed immediately after scattering the soil. Weed seed, however, may be scattered by this method.

3. Within the last few years a number of artificial cultures for inoculation have appeared. These cultures are usually satisfactory if they are secured from a reputable laboratory, are not too old, and are used as directed.

Job 5. Fertilizing Alfalfa

Conditions Usually Found.—(1) Alfalfa is seldom fertilized in the Great Plains and farther west. (2) The crop is commonly fertilized in the central and eastern states. (3) Most farmers do not realize that alfalfa uses more phosphorus and potassium than do many other crops.

Aims.—(1) Growers should know whether fertilizers are necessary for the crop in their locality. (2) They should know what fertilizers are necessary, what influences they will have on the crop and how they should be used.

Problems for Study and Discussion.—(1) How does the amount of phosphorus and potassium removed from the soil by alfalfa compare with that removed by other crops?

2. To what extent do local growers use commercial fertilizers for alfalfa?
3. To what extent are heavy applications used on other crops in the rotation, partly for the benefit of alfalfa? Give examples.
4. Under what conditions should nitrogen-bearing fertilizer be used for starting alfalfa?
5. Ask growers regarding the use of complete fertilizers on alfalfa.
6. How should rock phosphate be used?
7. When and how is commercial fertilizer applied to an established stand?
8. What rates of application of acid phosphate would you consider advisable?
9. Why do applications of acid phosphate help maintain a stand of alfalfa?

Activities.—Make trials to determine the effect of phosphoric acid for alfalfa on your soils. If soils are sandy, make trials with potash also.

Fertilizer Requirements.—The statement that alfalfa enriches the soil is made so often that it is a common belief that a field well established in alfalfa will take care of itself so far as plant nutrients are concerned. This is not the case because alfalfa, like every other crop, secures a large part of its nutrients from the soil. Four tons of alfalfa hay remove from the soil nearly 19 pounds of phosphorus and 193 pounds of potassium. In other words, such a crop removes about twice as much phosphorus and five to six times as much potassium as equivalent yields of other farm crops. The four-ton crop of alfalfa will also contain 200 pounds of nitrogen, but since this element can be obtained from the air, it is usually not necessary to consider it from the standpoint of a fertilizer except when a new stand is being established.

Most of the heavy soils of the United States are well supplied with potassium, but frequently it is not present in a form available to plants, especially in the eastern and southern states. Nearly all of the soils in the country are low in phosphorus.

In view of the foregoing facts it is not surprising that phosphorus is

the first fertilizer element to be considered and potassium the second. (See Appendix.)

Where Fertilizers are Needed.—Fertilizers containing both phosphorus and potassium are needed on most of the soils of the eastern and southern states and of the eastern Mississippi Valley region. In the eastern part of the Great Plains potassium can seldom be used with profit but phosphorus is frequently essential. In the light-rainfall sections and in the irrigated regions it is seldom that any fertilizer can be used successfully. Throughout the entire region where phosphorus is needed, a fertilizer containing some nitrogen can be used successfully at the time of seeding except where applications of manure have recently been made.

Influence of Phosphorus and Potassium.—Where there is a deficiency of either or both of these elements the alfalfa plants make a

Fig. 143.—Acid phosphate frequently doubles the yields of alfalfa hay. Left, acid phosphate and potassium sulphate; middle, potassium sulphate; and right, no treatment. (Kan. Agr. Exp. Sta.)

slow growth, the crowns do not develop properly, the yields are low and the crop is unable to compete with weeds and grass, which soon replace the alfalfa.

In those sections where fertilizers are necessary the increased yields resulting from their use vary from one-half ton to two tons per acre. Not only is the yield increased but the hay is of better quality, being more leafy in nature (Fig. 143).

Applying the Fertilizer.—The application of fertilizer for a new stand of alfalfa may be made just before seeding, or may be made at the time of seeding with a combination seed and fertilizer drill. If rock phosphate is used it should be plowed under with a green manure crop or incorporated in the soil with manure some time before seeding. After the

alfalfa becomes established the fertilizer can best be applied as a surface dressing in the spring at about the time growth starts.

In some localities a heavy application of fertilizer is made to the grain crop preceding alfalfa with the idea of also supplying sufficient nutrients for the alfalfa crop. As a general rule it is better to make the application direct to the alfalfa.

The rate to apply fertilizer varies from 150 pounds per acre annually in the western part of the fertilizer area to 400 pounds in the eastern part. Acid phosphate is the most generally used form in the western part of the area; such mixtures as 0–10–4 and 0–12–2 (N–P–K) are frequently used farther east; and 4–8–4 is commonly used at seeding time.

Sulfur has not been generally used as a fertilizer for alfalfa, but on some of the irrigated soils of the Northwest, especially in Oregon, applications of flowers of sulfur at the rate of about 100 pounds per acre have greatly increased the yields.

Job 6. Selecting Varieties and Good Seed

Conditions Usually Found.—(1) Many farmers purchase seed without regard to variety or adaptation. (2) Winter-killing or low yields frequently follow the use of non-adapted seed. (3) Poor lots often contain seeds of noxious weeds.

Aims.—(1) Students and breeders should know what varieties are best adapted to their locality. (2) They should be able to recognize the seeds of the more common noxious weeds.

Problems for Study and Discussion.—(1) What are the more common varieties of alfalfa?

2. What variety of alfalfa is seeded by local growers?
3. What may be the effect of using a non-adapted variety?
4. Describe Grimm alfalfa and give its adaptations.
5. Describe Peruvian alfalfa and give its adaptations.
6. What states produce most of the alfalfa seed?
7. Compare prices of different varieties in the market.
8. What weed seeds are most commonly found in alfalfa?
9. Examine several samples of alfalfa seed for impurities and decide which is the best?
10. How can you be sure you are purchasing good seed?
11. Why is good-appearing, clean seed not always safe to use?
12. What variety would you choose for your region? Why?

Activities.—(1) Collect samples of seed and examine each for impurities. (2) Test each lot for germination.

Varieties.—The more common varieties of alfalfa include Common, Grimm and Peruvian. These varieties are frequently given regional names as Kansas Common, based on the origin of the seed. Cossack, a hardy variety introduced by the United States Department of Agriculture about twenty years ago, has met with considerable favor in the Northwest.

The adaptation of a given variety of alfalfa is determined largely by winter temperatures, summer temperatures, rainfall and humidity (Fig. 144).

Common alfalfa is generally grown throughout the central states. Regional strains are grown in most of the irrigated sections and frequently in the Northwest. In the latitude of northern Nebraska, northern grown Common is quite generally used.

Grimm alfalfa is noted for its winter hardiness and is grown in those states where the winter is very severe. The seed of this variety usually costs much more than that of the common.

Peruvian alfalfa is of two kinds, Hairy and Smooth. These varieties are not very resistant to low temperatures but withstand a combination of high temperatures and humidity better than do other varieties. They are

FIG. 144.—The stand at the left was lost because non-adapted seed was used. (Kan. Exp. Sta.)

adapted primarily to western California, the southern part of the southern states and the Atlantic coast as far north as North Carolina.

Sources of Seed.—Most of the alfalfa seed is produced in the lighter-rainfall sections and in the irrigated regions. Kansas, Nebraska and the Dakotas produce much of the dry-land seed, and Utah, Idaho, Colorado, California and Nevada grow a considerable part of that produced under irrigation. Arizona and New Mexico produce considerable quantity of the less hardy strains.

Choosing Good Seed.—Alfalfa seed should be adapted to the region. In order to get adapted seed it is necessary to know the source or to purchase certified seed of an adapted variety. Good seed should be plump, bright, and yellowish in color, and should have a germination of 80 per cent or better. Seed may be two or three years old and still retain viability, but such seed should be tested for germination before being

used. Good practice is to purchase seed from a local grower; or to procure seed that has been produced practically as far north, or farther, as where it is to be seeded.

Weeds.—Seed of noxious weeds are commonly found in alfalfa seed. Some of the more common of these are curled dock, foxtail, dodder, plantain, bindweed, peppergrass, penny-cress and thistles. Seed containing such weeds should not be planted. Many of the weed seeds can be removed by the use of a good fanning mill, but some of them can not.

Job 7. Seeding Alfalfa

Conditions Usually Found.—(1) Many farmers seed so late in the fall that the plants do not make sufficient growth before winter. (2) Many farmers seed too early in the spring, and the plants are killed by a late freeze. (3) In some regions the crop is seeded when the soil is too dry.

Aims.—(1) Farmers should know the conditions necessary for the growth of young plants. (2) They should learn from the growers in their locality, the best time to seed.

Problems for Study and Discussion.—(1) Ask local alfalfa growers when they seed.

2. What must be the condition of the soil at time of seeding?
3. Why is August seeding usually best in humid regions?
4. Why is late fall seeding likely to result in failure?
5. What are the disadvantages of fall seeding in the light-rainfall sections?
6. What are the disadvantages of spring seeding in the humid regions?
7. Why should alfalfa not be seeded very early in the spring?
8. What is the common rate of seeding alfalfa in your locality?
9. What factors influence the amount of seed to sow?
10. Under favorable conditions, how many pounds of seed would you use per acre?
11. What are the advantages of seeding with the alfalfa drill?
12. How deep should alfalfa seed be covered?
13. What cultural methods are advisable after drilling? After broadcasting?
14. Under what conditions can a thin stand of alfalfa be improved by reseeding?
15. How many of the local growers use nurse crops for starting alfalfa?
16. What are the most common nurse crops for alfalfa?
17. Why are nurse crops not generally used?

Activities.—Practice seeding alfalfa by different methods. Compare the times required, and contrast results.

Time of Seeding.—The time of seeding alfalfa is determined largely by the moisture content of the soil, winter temperatures and prevalence of weeds. The crop is sown either in the late summer or early fall or in the spring. The late summer or early fall seeding is practised in those regions where winter conditions are not extremely severe and where it is more difficult to control such weeds as pigeon grass and crab grass. Where conditions permit, fall seeding is preferable because a good crop can be obtained the next season, while with spring seeding very little hay can be harvested the same season. Early fall seeding is adapted to the southern part of the irrigated region of the West, to the eastern Great Plains region and to most of the eastern and southern states. The seeding should be

early enough to permit the alfalfa plants to become well rooted and to make a good growth by winter. It should be late enough to avoid extremely hot dry weather and injury from summer weeds.

Spring seeding is practised in the northern states, on the summer-fallowed lands in the inter-mountain region and in the western part of the Great Plains, where it is usually too dry for fall seeding.

Rate of Seeding.—The rate of seeding will vary with the quality of the seed, the condition of the seed-bed and the method of seeding. On the irrigated lands of the West and in the light-rainfall sections the common rate is 12 to 15 pounds of seed per acre. In the more humid sections

FIG. 145.—The alfalfa drill insures uniform distribution and covering of the seed. (Kan. Agr. Exp. Sta.)

of the Central West this is usually increased to 18 or 20 pounds. In the South and in the Atlantic Coast States the rate is 20 to 22 pounds.

Method.—The two common methods of seeding alfalfa are drilling and broadcasting. Drilling with an alfalfa drill has many advantages over broadcasting (Fig. 145). The seed can be placed in a firm soil. A good uniform depth of planting and good covering and an even distribution of the seed are assured, and a better germination and more uniform stand are obtained. A common grain drill may be used, but it is difficult to keep from planting too deep. It also leaves too much open space between the rows and for this reason the seed should be drilled both ways if possible. Under most conditions it is advisable to go over the field with a culti-packer or subsurface packer immediately after drilling.

When alfalfa seed is broadcasted it is difficult to get a uniform dis-

tribution. It is seldom that the seed is well covered and frequently it is not brought in contact with moist soil. If the seed is broadcasted it should be covered with a smoothing harrow and the field should be culti-packed or rolled with rough roller at once.

Alfalfa seed should not be planted to a depth of more than about one-half inch.

Reseeding.—When fall-seeded alfalfa is a thin stand in the spring the stand may be improved by drilling-in additional seed. Spring-seeded stands may also be improved in the same manner in the early fall. After a stand has been established for a year or more it is practically impossible to improve it by the addition of seed.

A nurse crop offers direct competition with the alfalfa for both moisture and plant nutrients. Nurse crops are seldom used in seeding alfalfa except on some of the irrigated lands and in the North, and there are not many conditions which make their use advisable.

Most nurse crops are seeded either earlier in the spring or later in the fall than the best time for seeding alfalfa. Oats and barley are the most common spring-sown crops used for this purpose, but they are seeded several weeks before alfalfa should be seeded. In the flax-growing region this crop is very satisfactory if a nurse crop is to be used. Seeding in the fall with winter oats, rye or wheat postpones the date several weeks beyond the safe time for the alfalfa. A small-grain crop used in this way should be seeded at about one-half or two-thirds the usual rate.

When a nurse crop is used it should be harvested as early as possible in order to give the young alfalfa plants good opportunity for growth. Early harvesting is especially necessary in a dry season.

Job 8. Controlling Diseases, Insects and Rodents

Conditions Usually Found.—(1) Most farmers do not realize the importance of controlling alfalfa diseases. (2) Many of them believe that these diseases cannot be controlled. (3) Insect enemies are a serious menace to alfalfa production in many sections. (4) Most insects and rodents are not as difficult to control as many farmers believe them to be.

Aims.—(1) Alfalfa growers should learn to recognize the more common alfalfa diseases and insect pests. (2) They should know how diseases spread in the field and know the methods of control. (3) They should know the feeding habits of insects and rodents injurious to alfalfa and the methods of control.

Problems for Study and Discussion.—(1) What diseases have local growers found to be serious?

2. What are the characteristics of brown root-rot?
3. How should brown root-rot be treated?
4. What are the characteristics of bacterial wilt?
5. What are the best methods of avoiding this disease?
6. Describe alfalfa leaf spot.
7. Why would early cutting tend to control leaf spot?
8. Describe violet root-rot.

9. Examine plants from several fields for diseases.
10. What insects have local farmers found to be injurious?
11. Describe the work of grasshoppers and the methods of control.
12. How may cutworms and army worms be controlled?
13. How may garden webworm be controlled?
14. In what stages is the alfalfa weevil most destructive and how may it be controlled?
15. How does the pocket gopher injure alfalfa and how may it be eradicated?

Activities.—(1) Collect fresh specimens to show the effects of various enemies. (2) Preserve for the laboratory all insects and diseases which you can find.

Common Diseases.—Plant diseases are among the important factors controlling alfalfa production. In some sections the diseases become quite common and cause tremendous losses while in other sections they seldom occur. Diseases, as a rule, cause more injury in the humid than in the light rainfall regions.

The alfalfa crop is subject to several diseases such as the alfalfa wilt, various root-rots, leaf spot and yellowing.

Alfalfa Wilt.—This disease, which is commonly called *bacterial wilt*, attacks the roots; but its effects are most readily seen in the parts above the ground. A badly diseased plant is short, with spindly stems, small leaves, and a pale green color. Wilt is often most apparent in the first cutting; if the bark is stripped back from the root, an examination will show the woody cylinder to be a straw-yellow or brownish-yellow in contrast to the ivory color of a healthy plant.

The disease is more common in the humid regions than in others, is found in irrigated fields and occurs to a less extent in the dry-land regions. It may be carried in poorly cleaned seed, may be spread by flood water or by irrigation water. The best methods of avoiding the disease are to use clean adapted seed, to use good cultural methods, and not to reseed a field to alfalfa until after it has been used for other crops for a few years.

Root-Rots.—The brown root-rot which is found primarily in the Southwest and the violet root-rot which is more widely distributed are both fungous diseases. The fungus appears as threads on the roots of the plants. The entire plant becomes yellow and soon dies. The fungus gradually spreads so that the plants die in definite areas or spots in the field.

This disease can be controlled only by indirect methods. The most practical way is to practice a crop rotation for a few years. In the case of the brown root-rot only the monocotyledonous crops, as corn or sorghum, should be grown in the rotation.

Leaf Spot.—This disease attacks the leaves of the plants, causing small dark brown spots. When it becomes very severe the leaves fall from the plants. The best method of control is to harvest the crop at once.

Yellowing.—This disease occurs more generally in the humid regions, especially in the East, but has been found in the West. The entire plant becomes a yellowish-green color and growth is slow. It is commonly associated with conditions unfavorable for alfalfa but also occurs where conditions are favorable. The best treatment is to cut the crop when the disease appears regardless of the stage of growth.

Insects.—Alfalfa production in general has not been retarded by insect enemies. In local areas and during some seasons, however, the injury may be very severe. The most common of the insect pests are grasshoppers, various cut-worms, pea aphids and alfalfa weevils.

Grasshoppers are undoubtedly the greatest insect enemies of alfalfa throughout the Great Plains, and are frequently rather destructive in most alfalfa growing regions. They are especially injurious to young plants, destroying the growth as fast as it appears.

The best method of control is to use poisoned bran mash.[1] In preparing the mash twenty pounds of bran and one pound of white arsenic or Paris green are thoroughly mixed in a tub. The juice of three oranges or lemons and the peel of the fruit, chopped very fine, are then added to three and one-half gallons of water. Dissolve two quarts of cheap molasses in the water and wet the poisoned bran with the mixture, stirring so as to wet the mash thoroughly. The mash should be scattered broadcast very thin in the infested areas, early in the morning, about the time the grasshoppers begin to move about.

The hopperdozer is valuable for grasshopper destruction, especially during June and July and when the plants are not too tall.

Cut-Worms.—The variegated cut-worm and the army cut-worm occasionally do serious damage to alfalfa. The former do most of their damage to the first cutting of alfalfa. The latter usually do most of their damage in the early spring on alfalfa seeded the previous fall. They migrate as they feed, destroying the foliage of the entire plant. On warm days they hide in the soil at the base of the plants and feed at night.

The sowing of poisoned bran mash, made as for grasshoppers, is the best method of control. Although the mash may be broadcast on standing alfalfa or stubble, best results are obtained by sowing it under windrows or piles of hay at the time of the first cutting.

Pea Aphids.—These plant lice do most severe injury in the Great Plains region. The injury takes place in spots in the early spring and especially during dry seasons.

Some farmers control the insect when the ground is not too hard or the plants too large by thorough harrowing. A more effective method is to scatter calcium cyanide granules around the infested areas at the rate of

[1] Kan. Agri. Expt. Sta. Bul. 242.

twenty-five pounds per acre. Calcium cyanide is a poison and the dust must not be breathed. It should not come in contact with cuts or skin abrasions.

Alfalfa Weevils.—These insects do most injury in the irrigated sections of the West. They feed on the green leaves and frequently do serious damage.

The two methods of control in common use are cultivation after the removal of the first cutting and spraying. The spraying is most effective when done at the time the plants are showing serious injury. One acre of alfalfa requires two pounds of arsenate of lead powder and one hundred gallons of water.

Insects and Seed Production.—Many insects, such as bees, are beneficial to seed production because they assist with the pollinating processes. Other insects, such as the alfalfa-seed chalcid-flies, are destructive.

Rodents.—The pocket gophers are among the serious alfalfa pests. They eat the roots of the plants and throw up mounds which interfere with mowing.

Trapping is a common method of eradicating gophers but the best way to control them is to poison them with strychnine-treated wheat.[1]

The late fall and early spring are the best times to place the poison. The runways of the gophers should be located by use of a probe and in each runway should be placed a tablespoonful of poisoned grain.

Job 9. Cultivating and Controlling Weeds

Conditions Usually Found.—(1) Most alfalfa growers do not cultivate the crop. (2) Many farmers in the more humid regions cultivate the crop after the first cutting to destroy grasses. (3) Most farmers do not appreciate the importance of controlling weeds in alfalfa.

Aims.—(1) Students should know when to cultivate alfalfa. (2) They should know the types of implements to use. (3) They should know how to eradicate the more common weeds.

Problems for Study and Discussion.—(1) What is the opinion of local growers regarding the cultivating of alfalfa?

2. What are the objectives in cultivating alfalfa?
3. Under what conditions is cultivation desirable?
4. Name the implements used for cultivating alfalfa and give their comparative values for this purpose.
5. Why should cultivation usually take place just after one of the summer cuttings? Which one?
6. What detrimental results may follow the use of the disk harrow?
7. What weeds and grasses may be controlled by cultivation?
8. What weeds are injurious to alfalfa in your locality?
9. How may dodder be eradicated?

Activities.—(1) Test or otherwise compare the work of different implements for cultivating alfalfa. (2) Collect and name weeds found to be common in alfalfa fields.

[1] Kan. Agri. Expt. Sta. Bul. 242.

Cultivating.—As a general rule it is not profitable to cultivate alfalfa if the stand is satisfactory and grassy weeds are not causing trouble. Cultivation is frequently practised on a thin or weedy stand with the hope of improving it or of destroying the weeds. The two methods most commonly used are spring cultivation before growth starts and summer cultivation after removing the first crop of hay. The spring cultivation is usually done with the disk harrow or alfalfa renovator, and is supposed to thicken the stand. Such cultivation usually weakens the plants by splitting or cutting the crowns and roots and thus making them more susceptible to disease injury.

When grass and weeds come into an alfalfa field during the growing season they may be destroyed by cultivating immediately after removing a cutting of hay. The most effective time is after removing the first cutting. A spring-tooth harrow or similar implement may be used to best advantage for this purpose. The grasses that are most detrimental at this time are blue-grass in the North and East and crab grass in the South and West.

Quack Grass.—This is a very common and serious weed in the north central and eastern states. It spreads by rootstocks which are so deep that they cannot be destroyed by harrowing. The only method of control is to grow other crops on the land.

Bermuda Grass.—In sections of California and the South, Bermuda grass has become a serious weed in alfalfa. This is a perennial which spreads by seed and rootstocks and is very difficult to control. If the infestation becomes serious it is necessary to grow inter-tilled crops on the land.

Dodder may be classed as a weed or parasite because the seed germinates in the ground, but as soon as the weed makes sufficient growth to come in contact with the alfalfa plant it twines around the plant and obtains food from it. From this time on it is truly parasitic and spreads from plant to plant.

Since the weed usually occurs in patches, it can be controlled by cutting the alfalfa plants in these areas very close to the ground before the dodder produces seed. If the entire field is infested the ground should be plowed and other crops should be grown for three years before it is reseeded to alfalfa.

Weeds in New Stands.—Annual weeds are commonly a serious pest for the first year after seeding alfalfa, especially when the crop is seeded in the spring. Such weeds can usually be controlled by clipping the alfalfa rather high before the weeds produce seed. Frequent clipping at this time may severely injure the stand.

Job 10. Harvesting for Hay and for Seed

Conditions Usually Found.—(1) The alfalfa stand is frequently injured by cutting too frequently. (2) Too many leaves are lost from alfalfa hay because of poor curing methods.

Aims.—(1) Farmers and students should know the effect of frequency of cutting on the stand and on the quality of hay. (2) They should know how to make alfalfa hay with a minimum loss of leaves.

Problems for Study and Discussion.—(1) How many cuttings are obtained each year in your locality?

2. What yields are secured at each of the different cuttings?
3. What conditions of growth indicate the time for cutting?
4. Why should the crop be cut if the leaves are seriously turning yellow?
5. Why should the crop be cut immediately after a heavy frost if there is sufficient growth?
6. What is the effect of frequency of cutting upon coarseness of hay?
7. What is the effect of too frequent cutting upon the stand? Why?
8. What is the relation between stage of maturity and feeding value?
9. Describe the steps in cutting and curing alfalfa that best preserve the leaves.
10. Why is the side-delivery rake superior to the dump rake in making alfalfa hay?
11. Under what conditions is it advisable to bunch alfalfa hay?
12. Why is alfalfa seed not generally produced in humid regions?
13. Describe the harvesting of alfalfa seed.
14. What is a good yield of alfalfa seed?

Activities.—(1) Assist in the several operations in harvesting alfalfa for hay and for seed. (2) Time the different operations with a view to managing the distribution of teams and workmen.

Harvesting at the Right Time.—The quality and yields of alfalfa hay depend largely on the time the crop is cut and the way it is cured. Cutting alfalfa too frequently weakens the stand, while delayed cutting tends to improve the stand. When the crop is cut previous to the blooming period the plant draws heavily on the reserve food supply in the root, and if the practice is continued the plant is gradually weakened.

If the crop is not harvested until about the full bloom period, or until the basal shoots have made considerable growth, some reserve food may be stored in the roots for future use. The quality of the hay, however, becomes poorer as the cutting is delayed. The hay becomes coarser and the protein content is reduced. This is especially noticeable after the full bloom period or after the new shoots have started. Because of these conditions it is advisable to avoid both extremely early and late cutting.

It is usually safest to begin cutting when the plants are about one-tenth to one-half in bloom, or when the shoots have made a growth of not more than three inches. Occasional cuttings in the bud stage will do no serious damage. Cutting in the full bloom or seed stage strengthens the plants.

When alfalfa has been injured by late spring freezes, is badly infested with leaf spot or is losing leaves because of extremely dry weather, it is best to cut as soon as possible so that the new growth may make a normal

start. The last cutting in the fall should be made early enough to permit a growth of six or eight inches before cold weather.

Curing.—Since the leaves of alfalfa contain about twice as much protein as the stems, the most important factor in making the hay is to retain as many of the leaves as possible. The most effective way of doing this is to keep the leaves from becoming too dry before the stems have cured.

The methods of curing hay must of necessity vary with different climatic conditions. In the irrigated regions and in the Great Plains, where there is less danger of rainfall, one of the most successful methods is to leave the hay in the swath only until the top leaves are completely wilted and then throw it into a loose windrow with a side-delivery rake. The dump rake leaves the windrows too compact and checks further

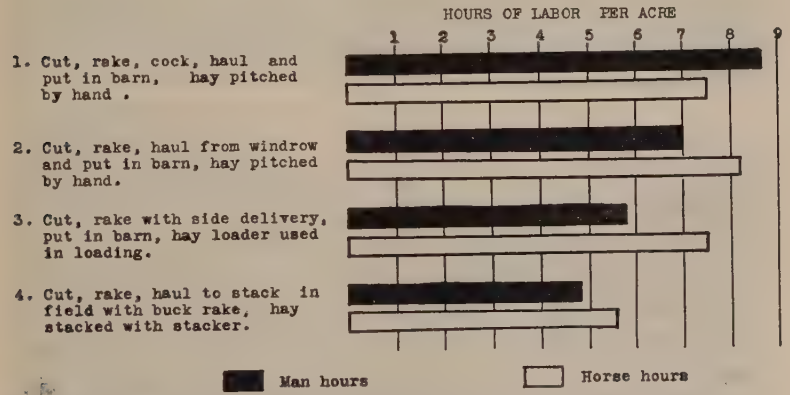
HOURS OF LABOR PER ACRE
1 2 3 4 5 6 7 8 9
1. Cut, rake, cock, haul and put in barn, hay pitched by hand.
2. Cut, rake, haul from windrow and put in barn, hay pitched by hand.
3. Cut, rake with side delivery, put in barn, hay loader used in loading.
4. Cut, rake, haul to stack in field with buck rake, hay stacked with stacker.
Man hours
Horse hours

FIG. 146.—Time and labor required in harvesting alfalfa hay by different methods. U. S. Yearbook 1924.

curing. Air should circulate freely through the hay and cure it without danger of heavy leaf loss. These windrows may be turned with the rake frequently enough to bring about complete curing. It is very seldom that extensive alfalfa growers in these regions bunch the hay. They usually bale or stack it direct from the windrows. In the more humid sections of the Great Plains it is usually safest to stack the first cutting or store it in a barn, where it may be baled later if desired (Figs. 146 and 147).

In the more humid sections the slower curing and danger of rainfall must be considered. In such regions it is a good practice to cut in the morning and rake into windrows with a side-delivery rake in the afternoon (Fig. 148). It may be necessary to turn the windrows late the next morning if there is a heavy cutting. The hay can then be bunched as

soon as the stems become fairly dry. Bunching is necessary only when there is danger of rain.

Producing Seed.—Alfalfa is very uncertain as a seed crop; and it is difficult to estimate early in the growth of the crop, with any degree of accuracy, what the seed crop will be. Sufficient moisture in early stages of growth for normal plant development and relatively dry weather during the blooming period are essential for seed production. Heavy rainfall during the blooming period or after the seed has formed tends to cause vegetative growth and hinders seed production.

Fig. 147.—The hay-loader in operation. (Kan. Agr. Exp. Sta.)
Fig. 148.—The side-delivery rake leaves an open windrow which aids in the curing of the hay. (Kansas Agr. Exp. Sta.)

Harvesting Seed.—In a favorable season when blooming and maturing of the seed have been uniform it is best to harvest when about two-thirds of the pods have turned brown. At this stage the seed will be sufficiently well matured and there will be a minimum of shattering. Under average conditions, a part of the seed will be over-ripe, some will be mature and some immature. With such a crop it is necessary to harvest when the largest amount of good seed can be saved.

A machine for harvesting alfalfa seed should be one that cuts and automatically rakes or bunches the crop. This may be accomplished with

the self-rake reaper, the mower with bunching attachment or the grain binder with the binder attachment removed. If the plants are of sufficient height to permit binding, the crop may be harvested and bound with the grain binder. Under some conditions the combine or the header is practical. When the crop is cut and bunched it should be placed in small shocks as soon as possible, or at least while it is still tough or damp. It usually requires from five to ten days for the crop to become sufficiently dry for threshing or stacking.

Alfalfa and clover hullers are the best machines with which to thresh alfalfa seed but the later models of grain threshers may be adjusted to do good work.

Job 11. Using and Marketing the Crop

Conditions Usually Found.—(1) Many farmers do not appreciate the superior feeding value of alfalfa. (2) In many sections farmers are afraid to pasture alfalfa while in others the crop is freely pastured.

Aims.—(1) The various uses of alfalfa should be known by growers. (2) They should know its relative value in their locality for feeding purposes and as a cash crop.

Problems for Study and Discussion.—(1) What uses are made of alfalfa in your locality?

2. To what kind of livestock is alfalfa hay fed?
3. How can alfalfa hay be best utilized?
4. What precaution must be considered in pasturing alfalfa?
5. For what livestock is alfalfa best adapted for pasturing?
6. Describe the making of alfalfa meal.
7. What uses are made of alfalfa meal?
8. Under what farm conditions is it advisable to sell alfalfa hay?
9. How does the price of alfalfa hay compare with the price of other hay in your locality?
10. What is the market for most of the hay?
11. How, when and at what prices is alfalfa seed sold by producers?

Activities.—(1) Practise judging different lots of alfalfa hay. (2) Collect samples of alfalfa meal for comparison. (3) Assist in loading and shipping alfalfa. (4) Graph the prices of alfalfa for several years. Compare these with prices of clover.

Hay.—Alfalfa hay has no equal as a feed for dairy cows and growing cattle of all types. It may also be used successfully for horses and sheep and to some extent for swine and chickens. It can be used economically under most conditions, as a feed for dairy cows, by feeding with silage and grain. Young calves, swine, and chickens should have alfalfa with a high percentage of leaves and as few woody stems as possible. Because of its high protein content, the use of alfalfa hay decreases the necessity of purchasing concentrated feeds.

Soiling.—Alfalfa as a soiling or green-feed crop may be used successfully for milk cows, calves and chickens. The cattle should not be given an excessive quantity at one time. In cutting alfalfa as a soiling

crop it is necessary to guard against cutting the plants too frequently from the same area or the stand will be injured.

Pasturing.—In the lighter-rainfall regions alfalfa is used successfully as a pasture for all types of livestock. It is usually considered most valuable for cattle, swine, horses and chickens. Sheep are sometimes pastured successfully, but they eat the plants so close to the ground that they injure the stand. Horses may also cause the same type of injury. Continued close grazing by any type of livestock will injure the stand and should not be practised.

Bloat is more likely to occur with cattle and sheep than with other kinds of livestock. This trouble may largely be prevented if animals are not put in the field while the plants are damp with dew or rain. Hungry livestock should not be put in an alfalfa field because of danger of overeating. The animals should be well fed before being turned into the pasture. As soon as they become accustomed to alfalfa pasture there is little danger of bloat.

Silage.—In some regions where it is difficult to cure alfalfa hay the crop is placed in a silo. Alfalfa alone makes a poor grade of silage which is not palatable to livestock. When this use is made of the crop it should be placed in the silo while green or when quite damp from rain and should be mixed with sorghum or corn.

Meal.—Alfalfa meal consists of finely ground alfalfa leaves and stems. Usually the highest grade pea-green hay should be used for this purpose. The meal is no higher in feeding value than hay of the same quality. Frequently, however, it is easier to handle and feed and is used quite generally for poultry, calves and swine.

Straw.—The straw which remains after threshing alfalfa seed is returned to the soil in some localities; in others it is used as feed. Its chief value as a feed crop is for mature cattle and horses. Young stock and sheep do not eat it readily.

Marketing.—In those regions where more alfalfa is produced than can be utilized on the farm and where transportation costs are not too high, hay may be produced successfully as a cash crop. California, Nebraska, Kansas and other western states produce most of the alfalfa hay that is placed on the market. Most of the marketed hay goes to the dairy sections of the central, southern and eastern states. With the exception of local sales, practically all of the hay going on the market is baled.

The price received for the hay varies materially from year to year and with location. It is usually materially higher than that of other types of hay. Clean, pea-green, leafy hay demands the highest price.

Seed.—With the exception of that sold to local growers, most of the alfalfa seed is placed on the market through the seed brokers, larger seed houses, state organizations or alfalfa-seed coöperative organizations. The better grades of seed are bagged, sealed and placed on the market as certified, registered or pedigreed seed.

Yields of alfalfa seed vary from two to ten bushels per acre. A yield of six to eight bushels per acre is considered to be very satisfactory. The price varies from fifteen to twenty-five cents a pound for high-grade seed of common alfalfa. The seed of Grimm and other northern strains usually sells at about twenty cents more per pound than the common.

Job 12. Irrigating Alfalfa

Conditions Usually Found.—(1) In many sections of the West, alfalfa is one of the most important irrigated crops. (2) Excessive irrigation is practised in some localities and is injurious.

Aims.—(1) The amount of water necessary for maximum yields varies with conditions and students should know the requirements for their locality. (2) They should know the proper time and methods of irrigating in their neighborhood.

Problems for Study and Discussion.—(1) Where is alfalfa generally irrigated?
2. What methods do local farmers use in irrigating this crop?
3. How much water is applied at each irrigation?
4. How many applications are made each year? When?
5. What is winter irrigation and under what conditions is it used?
6. What are the dangers of excessive irrigation?
7. When is it not advisable to use the flood system of irrigation?

Activities.—If possible make a trial to compare methods of applying water, quantity used, and frequency of application.

Regions.—Alfalfa is commonly irrigated in the arid and semi-arid sections of the United States. In some portions of this region irrigation water is used to supplement rainfall while in others it is the sole source of water for the crop.

Methods.—The flooding system is used more generally than any other for this crop, because it interferes less with the use of harvest machinery. The closed-field system is being used to some extent in those areas where there is danger of spreading crown and root diseases from the open field flooding. In this method the field is divided into blocks of one acre or more in size and each block is irrigated independent of the remainder of the field. Furrow irrigation is sometimes used, but is not generally adapted to alfalfa production.

Use of Water.—The number of irrigations and the amount of water required vary with the soil, rainfall, number of cuttings and yields secured. The number of applications vary from four in the northern states, where the season is shorter, to ten or twelve in the Southwest.

In those sections where plenty of water is available and the soil is in good condition, about sixty inches of water a year can be used economically

if the growing season is long. Forty-eight inches is usually sufficient where the growing season is short.

The first application of water should be made in the early spring before growth starts except where there is sufficient moisture from winter and spring rains and snow. Throughout the season water should be applied after each cutting. It is also frequently necessary to add more water between cuttings. If the plants wilt or the soil becomes dry to a depth of a foot it is advisable to use more water.

The amount of water to apply at one time varies from five to twelve inches, depending largely upon the soil. Soils that tend to water-log and those having alkali salts in the lower subsoil should have lighter and more frequent applications. Excessive irrigation should always be avoided because of danger of water-logging, of dissolving soluble salts of the lower subsoil and thus increasing the concentration in the root zone of the soil, and because it is a waste of water.

Winter Irrigation.—When there is a deficiency of water during the growing season and an abundance during the winter and spring it is a common practice to make heavy applications of water while the plants are in a dormant stage. In this manner sufficient water may be stored in the soil to produce a fairly satisfactory crop. Winter irrigation should not be practised where the winters are extremely cold because the wet soil will make the plants more susceptible to winter injury. In a mild and relatively dry winter climate, winter irrigation is frequently desirable even when there is sufficient water for use during the growing season.

Excessive Irrigation.—There is frequently a tendency to use too much water at one time, especially in those sections where water is abundant in some seasons and deficient in others. This practice is never advisable and is especially objectionable on heavy soils, because it injures their structure, and on soils that are underlain by a substratum having a high concentration of alkali salts.

Job 13. Summarizing the Records

Conditions Usually Found.—(1) Relatively few farmers keep records of costs and returns. (2) Those who keep records find it worth while.

Aims.—Simple, clear methods of keeping records should be understood and used by students. (See corn enterprise.)

Things to Make at Home.—A hood for a lime spreader; repair hay-making machinery if needed; a hay rack; a lime spreader as shown in figure; make wheelbarrow seeder.

References to State Bulletins and Circulars.—Mich. Sp. 97; Mo. Circ. 6; Tenn. 135; Minn. Tech. 38; Neb. Research 36; Kan. Tech. 15, 242; Del. 110; Cal. 280.

SWEET CLOVER ENTERPRISE

Most of the jobs in this enterprise are similar to those with alfalfa. Sweet clover or mellilotus is a biennial producing no blossoms the first year but producing blossoms and seed the second year and then dying. The crop is grown in all states and in Canada. It will even thrive in rocky places where other crops will not thrive, particularly if the rocks are limestone. An abundance of lime in any soil will greatly improve the yields. Seed beds are made about as for alfalfa. Two cuttings of hay are usually secured the second season, or with the annual form, called Hubam, one cutting the first season. If it is sown early in the season in southern states it may be cut toward the end of the first season, and twice the second year. The bitter taste in the plants causes animals to avoid eating it until they have been induced to like it. The stems become very woody, which makes the crop hard to cure and less palatable. Its chief advantage lies in its endurance of soils unsuited to the growth of alfalfa. See U. S. Farmers' Bulletins 797, 836, 1005.

PEANUT ENTERPRISE

By Walter S. Newman, B.A., M.S.
Virginia State Supervisor Agricultural Education

Analysis into Jobs.—The following are the main jobs for growing and marketing peanuts. References are made to U. S. Farmers' Bulletin 1127, and others.

1. Determining the possibilities with peanuts.
2. Determining area, rotation, and choosing field.
3. Choosing the variety.
4. Preparing the soil for peanuts.
5. Fertilizing the peanut crop.
6. Planting the crop.
7. Cultivating peanuts.
8. Harvesting peanuts.
9. Picking peanuts.
10. Marketing peanuts.
11. Keeping accounts and interpreting the results. 511, 572, 782, 1182.

Job 1. Determining the Possibilities with Peanuts

Conditions Usually Found.—(1) The soil and climate in certain sections are quite favorable for the production of peanuts. (2) Many farmers are producing peanuts at a loss.

Aims.—(1) The student should know before attempting to grow peanuts what may be expected in returns and profits. (2) He should know to what extent the losses of local farmers can be avoided and profits increased.

Problems for Study and Discussion.—(1) What percentage of the farmers in your section grow peanuts?
2. Get their opinions regarding the suitability of local soils and climate for this crop.
3. How much labor per acre is required in growing the crop in your community?
4. What is the average yield per acre in your county?
5. What has been the average price per pound for the last five years on the local market?
6. Ask farmers to explain the trend in prices.
7. Are the profits from growing peanuts increasing or decreasing? Why?
8. To what market could you sell your crop?
9. What uses are made of local crops?

In deciding whether or not to grow peanuts several factors must be considered: climate, soil, labor required, machinery necessary, yields that may be expected, and demands of the market.

Climate.—Peanuts demand a warm climate and grow better in low than in higher altitudes. The cool nights in the higher sections retard the proper development of the crop. The larger varieties require from

130 to 150 days to mature. Peanuts seem to thrive better in dry than in wet seasons, although excessive drouth will result in a poor crop.

A light sandy soil will produce the best-quality peanuts. Light sandy loams will give a larger yield but the quality will not be quite so good. If the soil is not light in color the hulls of the peanuts will be stained, and this results in lower prices at marketing time. A soil that will bake or pack easily is not suited for peanuts as the "pegs," or fruit stems, cannot grow down into such a soil readily. Peanuts also demand a well-drained soil. If the soil is poorly drained, a baked condition is likely to occur and the presence of too much water will cause the hulls to become stained and in some cases may cause rotting.

Labor.—A summary of the records for fields of students of vocational agriculture shows that from 70 to 80 man-hours are required to grow an acre of peanuts for market. If the crop is to be hogged down this time requirement may be reduced approximately 45 per cent. The horse-hours required per acre range from 60 to 70.

The implements generally used in growing the crop are ordinary two-horse turning plow, single-row planter, weeder, light small-toothed cultivator and a cotton cultivator. A one-horse plow provided with a cutting point is generally used in harvesting. Threshers or pickers are very economical and several farmers often purchase these machines jointly. In many sections a large number of growers follow the practice of having the crop picked by custom machines.

Yields of 60 bushels, of the larger varieties, should ordinarily be expected if improved methods of production are followed. The average yield secured by students of vocational agriculture in Virginia over a period of years is 80 bushels per acre. An analysis of the records of these students shows that they have made an average net profit of $35.00 per acre.

There is a good demand for high-quality peanuts of the larger varieties. Peanuts of smaller size and lower quality are being produced cheaply in foreign countries and although a protective tariff is operating to the advantage of the American farmer, it cannot be said that there is a great demand for peanuts of less than the highest quality. If the peanut crop is hogged down, the Virginia Experiment Station states that "one acre of Spanish peanuts of 40 bushels will produce from 400 to 500 pounds of pork." When the crop is harvested for market a good many peanuts are left in the ground, and if hogs are turned in these fields they will make considerable gain on these nuts.

Job 2. Determining Area, Rotation, and Choosing Field

Conditions Usually Found.—(1) In some peanut-growing sections there is a tendency for farmers to grow too many acres of cash crops and not enough hay

and soil-improvement crops. (2) A proper rotation of crops is often not followed in the peanut-growing sections.

Aims.—(1) Students should learn the necessity of developing a balanced farming program. (2) They should realize that successful production is dependent upon soil fertility and that this can best be brought about through proper crop rotation.

Problems for Study and Discussion.—(1) How many acres of peanuts are grown in the average fields in your section?

2. Why does the acreage vary on different farms and from year to year?
3. How many of the farmers in your section produce enough hay and pasture for their farm animals?
4. To what extent do they feed a part of the peanut crop?
5. What are the main crops grown in your section?
6. Study the amount of labor demanded by these crops at the same time that the peanut crop needs attention.
7. What crop rotations are generally followed on local farms which grow peanuts?
8. What crop or type of crop should precede peanuts?

Activities.—Make a table showing the names of several growers with the acreage, variety, kind of soil, yield and crop which precedes peanuts shown in different columns.

The rotation being followed will determine to some extent the number of acres that should be planted in peanuts. Successful production of peanuts cannot be expected unless a good rotation is followed. The Virginia Experiment Station recommends the following rotations for peanuts.

Rotation Number 1.

1st year, peanuts.
2nd year, cotton, with crimson clover sown at the last cultivation.
3rd year, corn, with crimson clover sown at the last cultivation.
4th year, soybeans, with rye or crimson clover as a winter cover crop.

This rotation may be modified by planting soybeans with the corn crop. The winter cover crops may be turned under for green manure or grazed with hogs or cattle during the winter or early spring and the crop residue turned under.

Rotation Number 2.

1st year, early potatoes, followed by cotton planted between the rows, with crimson clover seeded at the last cultivation.
2nd year, corn and soybeans, crimson clover seeded at last cultivation.
3rd year, peanuts.

It is assumed that when this rotation is used the land will be double-cropped with potatoes and cotton the first year and that hogs will utilize the peanuts left in the field and the winter cover crops as well. Farms not growing cotton the first year may use a truck crop or corn in place of cotton, or use Rotation 3.

Rotation Number 3.

1st year, peanuts.
2nd year, corn and soybeans, with crimson clover sown at the last cultivation.
3rd year, soybeans followed by rye to be plowed under in the spring.

It is apparent from these rotations that hogs should be grown on peanut farms. Peanuts add materially to the flavor of cured pork. Do not feed to excess, as peanuts alone produce soft pork. A careful survey should be made of the amount of feed needed to maintain the cattle and work-stock on the farm. After this has been determined a rotation for the production of hogs, peanuts, cotton, corn and other crops can be decided upon.

FIG. 149.—Virginia bunch peanuts, the highest type for roasting. (U. S. Dept. Agr.)

Job 3. Choosing the Variety

Conditions Usually Found.—(1) Several varieties of peanuts are often grown in one section. (2) Often the demands of the local market are not seriously considered in choosing the varieties.

Aims.—(1) The grower should realize the importance of choosing the variety that will best suit his conditions and bring him in the greatest profit. (2) He should learn the demands of the markets and attempt to produce the product that will bring the highest returns.

Problems for Study and Discussion.—(1) What varieties of peanuts are found in your section?

2. Are the peanuts in your section sold for vending purposes or as shelled peanuts?
3. How many farmers practise hogging off the entire crop?
4. What variety of peanuts brings the best price per pound in your markets?
5. What varieties produce the largest yields per acre in your community?
6. How many farmers in your community practise careful selection of seed peanuts?
7. List the varieties and give their purposes.

Two Types.—Peanuts fall into two groups—bunch and runner. The bunch varieties, as the name implies, have an upright growth and form pods in a cluster around the tap root. The runner varieties are spreading in their growth and form pods along the lateral stems. It is difficult to cultivate the runner varieties as the vines fasten themselves to the ground, and great care has to be exercised in removing grass so as not to reduce the yield.

Large Varieties.—Virginia bunch (Fig. 149) is a large-podded variety of the upright type. Virginia Runner and Jumbo are large-podded vari-

FIG. 150.—Spanish peanuts: a small-seeded variety much used in making candy.

eties with the spreading habit of growth. The Jumbo furnishes the largest pods of any of these varieties and is used extensively for vending. The Virginia Station had secured larger yields from Jumbo and Virginia Runner than from the Virginia Bunch variety.

Small Varieties.—Of the smaller-podded varieties the Spanish (Fig. 150), Improved Spanish, Valencia, and Georgia Red are representatives of the upright types. The North Carolina or Wilmington and Tennessee White Skin have the spreading habit of growth and produce pods of medium size.

Varieties for Profit.—The Virginia Runner, Jumbo and Virginia Bunch have proven the most profitable varieties in Virginia and North Carolina. Outside of this belt the Spanish and the Improved Spanish are the most popular commercial varieties. The Wilmington and Tennessee

White Skin are good shelling stock. Most of the other small-podded varieties mentioned are used for hog feeding.

Selecting Seed.—No crop will respond more readily to seed selection than the peanut. Seed should be saved from mature plants and from those having the greatest number of sound, mature pods. Care should be exercised to see that these selected plants are thoroughly mature before stacking.

FIG. 151.—Cowpeas make one of the very best crops to plow under for green manure, preceding the peanut crop. (U. S. Dept. Agr.)

FIG. 152.—At left, peanut project not preceded by green manure. At right, project of equal acreage preceded by green manure. (High School.)

A seed plot, using a few of the best pods from the selected plants, is a profitable practice. It is remarkably easy to increase the size of the variety and hence secure a better price. This phase of peanut growing has been sadly neglected.

Job 4. Preparing the Soil for Peanuts

Conditions Usually Found.—(1) Some farmers do not pay enough attention to the preparation of land for peanuts. (2) The best growers find that attention must be given to plowing-under the preceding crop if the best results are to be secured.

Aims.—(1) Farmers should learn the benefits of proper preparation of the seed bed. (2) They should secure information as to when certain cover crops should be plowed under.

Problems for Study and Discussion.—(1) What depth of plowing for peanuts is practised by the farmers in your community?
2. When is most of the land broken for peanuts?
3. What crop generally precedes peanuts in your section?
4. Is level or ridged cultivation practised by the best farmers? Why?
5. How does the type of soil affect the system of soil preparation?
6. How many weeks elapse between plowing and planting time?
7. How many times is soil harrowed during this time?
8. Get opinions of growers as to the benefits of several harrowings.

In most of the southern states peanut land is prepared similarly to land that is to be planted in corn. Careful preparation of the land before planting will prove profitable, as the peanut is not as easy to cultivate as some of our crops. If there is no winter cover crop on the land it is a good practice to plow rather early in the spring and allow the land to settle before planting. Harrowing with a light harrow will aid in conserving moisture and in preventing weed growth.

Later plowing is recommended if clover or rye is used as a winter cover crop. These crops should be plowed under before their growth becomes too heavy in order to allow time for the decay of the plants and for the settling of the soil before planting time (Figs. 151 and 152).

In most sections a level seed bed is used, but if the land is heavy and poorly drained slight ridges should be thrown up so that the peanuts can be planted somewhat above the level of the land.

Job 5. Fertilizing the Peanut Crop

Conditions Usually Found.—(1) Farmers use widely different methods of fertilizing peanuts. (2) Considerable quantities of fertilizing materials are wasted in some sections in growing peanuts.

Aims.—(1) Students should know how the peanut reacts to the application of the different plant-food elements. (2) He should learn how to supply the needs of the crop in the most economical manner.

Problems for Study and Discussion.—(1) How many farmers in your community apply fertilizer directly to the peanut crop?
2. What fertilizers are generally used?
3. What do your best farmers think about using lime on peanut land?
4. Should fertilizers and lime be spread broadcast for peanuts? Why?
5. To what important family does the peanut belong?
6. How can the ordinary fertilizing practices for peanuts in your section be improved?
7. How are fertilizers purchased? When?
8. Get opinions of growers as to coöperative buying and home mixing.

Activities.—Collect tags and make lists of materials used in fertilizing peanuts in your region.

Station Findings.—Virginia conducted extensive experiments with fertilizers for peanuts. The findings are summarized as follows: "Large

applications of nitrogen on fairly productive soils produce a poor quality of peanuts. The yields are not increased although more vine growth is produced, which tends to delay maturity. On light sandy soils deficient in organic matter the application of organic nitrogen in connection with phosphorus often pays.

"**Phosphorus** seems to give better results than any other element. Potash gives good results on sandy but not on darker soils. Acid phosphate at rates from 300 to 500 pounds per acre, to hasten maturity, is the only fertilizer recommended on heavy fertile soils. A 2–8–2 (N–P–K) fertilizer will pay on light sandy soils which are lacking in organic matter."

Fig. 153.—Base of peanut plant, showing seeds, roots and nodules. (U. S. Dept. Agr).

Growers who practise good rotations such as mentioned in Job 2 produce from 60 to 100 bushels of peanuts per acre if proper attention is given to fertilizers for the other crops in the rotation. When other crops in the rotation receive the proper application of fertilizers it is necessary to apply only phosphorus to the peanut crop. When fertilizer is used it should be applied in the drill before planting, using one of the common fertilizer distributors.

Lime is very essential in the production of a good yield of high-quality peanuts. Land plaster (gypsum) has been used in large quantities in the

past, but when lime is used better results are generally secured. If less than 500 pounds of lime is used per acre it should be applied in the drill before planting. Lime should be broadcast every three or four years when it is used in larger quantities. Care should be used in making heavy applications of lime to light land, as damaging effects may be secured from too heavy applications.

The peanut is a member of the legume family and derives considerable nitrogen from the air. Inoculation for the crop has not been necessary in most sections where it has been grown to any great extent (Fig. 153).

Job 6. Planting the Crop

Conditions Usually Found.—(1) Considerable variation occurs in the practices followed by farmers regarding the rate of seeding per acre, distance between rows, distance between plants and surface of soil. (2) Some farmers follow the practice of planting peanuts much earlier than the average time.

Aims.—(1) The grower should become familiar with the recommended rate of seeding for the variety he is to grow. (2) He should know how and when to plant to secure maximum returns.

Problems for Study and Discussion.—(1) When do most of the farmers in your section plant the peanut crop?

2. Is it profitable to plant by hand? Why?
3. What distance between rows has given best results for the varieties generally grown in your section?
4. Is it the practice to plant hulled nuts or peanuts in the shell in your section?
5. What differences in germination are noticed?
6. What type of planter has been found to give best results?
7. Give the different rates of planting.
8. Describe depth of covering for different soils.

If shelled peanuts are used for planting they should be shelled by hand, and care should be exercised not to break the red covering of the seed. Large-podded varieties are generally shelled, while the smaller varieties are usually planted in the pod. Three bushels of unhulled or one-half bushel of hulled nuts of the larger varieties are required to plant an acre. One and one-half bushels of Spanish peanuts are generally used per acre. Planting can best be done with a one-horse planter, of which there are several good makes on the market.

The rows are generally laid off with a one-horse marker. If fertilizer is used it is then drilled in the row and the peanut planter follows the fertilizer drill.

The large-podded varieties are generally planted between April 15th and May 15th. The land, however, should be thoroughly warm before the crop is planted. Approximately 130 days are required for the larger varieties to mature, while the smaller types need only about 90 days in which to ripen. Good results have been secured in the south with the smaller varieties when planted as late as July 10th.

Distances.—In light soils the seed should be covered to a depth of from 1½ to 2 inches, while in heavier soils the depth should be from 1 to 1½ inches. Distance between rows and between plants varies with the section and the purposes for which the crop is grown. The vines should be close enough to meet and cover the ground when full grown. The upright varieties are generally spaced from 2 to 2¾ feet between the rows while the spreading types require from 2¼ to 3¼ feet. Six to 12 inches apart in the drill is generally allowed for the bunch varieties and from 9 to 16 inches for the spreading types.

Job 7. Cultivating Peanuts

Conditions Usually Found.—(1) Some farmers do not pay enough attention to cultivating during the early stages of the crop's growth. (2) The eradication of grass from the crop causes considerable trouble on many farms.

Aims.—(1) The student should learn the importance of keeping the young crop free from weeds and grass. (2) It is especially important that the soil be kept loose, and the student should realize the importance of this.

Problems for Study and Discussion.—(1) At what stage of the plant's growth is the first cultivation given in your section?

2. Why is it so important to keep the soil loose in securing a good yield of peanuts?
3. How can you eliminate hoe work in cultivating the crop?
4. What implements will give best results in cultivating peanuts?
5. How many cultivations are given this crop locally?
6. What conditions indicate need of cultivation?
7. When should the cultivation of the crop be discontinued?

Loose Soil.—Peanuts need frequent, shallow cultivations. It must be borne in mind that after the blossoms form the stems grow and "peg" down into the ground where the peanut is formed. If the soil is not in a loose condition the pegs cannot enter. The first cultivation should be given with a light weeder before the peanuts come up. The weeder is run at right angles to the rows, and this working breaks the crust, if one has formed, and destroys young grass and weeds.

Cultivators.—The five-tooth single-row cultivator is a popular implement for subsequent cultivations. Narrow shovels should be attached for the early cultivations and the cultivator should be run very close to the row. As the vines grow, larger shovels can be attached and more dirt thrown towards the row. After the plant begins to peg down, care must be exercised not to disturb the stems that have entered the ground.

The later cultivations are often given with a cotton or corn cultivator fitted with short sweeps. Frequent and late cultivations are highly advisable. These practices will reduce hoe work to a minimum. If the crop is left entirely clean after the last late cultivation, harvesting is made much easier and a high percentage of marketable peanuts is secured.

Job 8. Harvesting Peanuts

Conditions Usually Found.—(1) The methods of harvesting peanuts vary in different sections. (2) In many cases when peanuts are harvested for market the quality of the crop is impaired and the quantity of marketable peanuts reduced because of the necessity of handling the crop quickly.

Aims.—(1) The student should learn when the harvesting operation should begin if maximum results are to be secured. (2) He should ascertain what system of harvesting will net the greatest profit under his conditions.

Problems for Study and Discussion.—(1) Are peanuts grown more for market or for hog feeding in your section?

2. What varieties bring the best prices in the local market?
3. How can you tell when peanuts are ready to dig?
4. What machine will harvest nuts with the smallest loss in your section?
5. Why is the practice of stacking peanuts followed in curing the crop?
6. How much time is required for peanuts to cure properly in the stack?
7. Get opinions of growers on the use of stack covers.

Activities.—Assist in harvesting and curing peanuts by different methods.

Factors to Consider.—The large-podded varieties are usually picked for market and the vines fed to stock or spread back on the ground. The smaller varieties are often hogged-down. The price per pound of the variety, the saving in labor, the difference in price between corn-fed hogs and peanut-fattened pork, are some of the important factors that must be considered in determining the best methods of harvesting.

Judging Maturity.—When to begin digging the crop is a very important consideration. All of the pods cannot be saved, but the aim should be to harvest as many mature pods as possible. The shedding of the leaves is one of the indications of maturity. Some farmers pull up a plant occasionally; after allowing it to hang in the sun for a few hours they are able to get an idea of the stage of maturity. The immature pods will shrivel and the proportion of mature pods can be ascertained.

Types of Diggers.—In digging, the tap root should be cut just below the depth at which the pods form. As much of the main root as possible should be left in the ground so that the nitrogen-bacteria nodules will remain to inoculate the soil. Several types of harvesters are in use and the efficiency of each varies with the type of soil. An ordinary turning plow, with mold-board removed and a point or wing attached to the point of the plow, gives as good results as any implement. This plow is run down both sides of the row loosening the peanuts from the soil and cutting the roots at the desired depth. It is then necessary to shake the soil from the vines and allow them to remain on the top of the ground for several hours. The potato digger is used to some extent in harvesting the crop, as this not only loosens the plants but also shakes the soil from the vines. On stiff soil, however, there is considerable loss of peanuts torn from the vines.

Stacking.—After the vines have remained in the air until they have wilted but have not become brittle they should be stacked. The Virginia

Station Bulletin 218 describes this operation as follows: "For stacking, a small pole about 7 feet long and 2 to 3 inches in diameter is used (Figs. 154 and 155). It should be set in the ground deep enough and tamped sufficiently to keep the stack from being blown over. One or two strips about 15 inches long are nailed high enough above the ground so that the peanuts will not be damaged by moisture from the soil. From these the stack is built up in successive layers to the top. Care should be taken to keep the peanuts hidden as much as possible, as a protection from weather

FIG. 154.—Peanuts stacked in the field about poles, in this manner, cure nicely without discoloring. (U. S. Dept. Agr.)

and from birds. Caps are sometimes put on the stacks, but they often interfere with circulation of air and prevent proper drying. Three or four weeks of drying are needed before the peanuts are ready to be picked." After picking and the removal of the peanuts from the field the hogs can be turned in. They will utilize the peanuts that were lost in harvesting for market.

Job 9. Picking Peanuts

Conditions Usually Found.—(1) Practically all peanuts for market are machine-picked. (2) More care should be used in cleaning and preparing a quality product for the market. (3) Many farmers would probably increase their profit if they purchased threshers instead of continuing to have their crop custom-picked.

Aims.—(1) The student should become familiar with the conditions under which it is advisable to own a peanut picker. (2) He must consider the saving o labor and learn how to get the largest number of high-quality peanuts and save the greatest amount of hay.

Problems for Study and Discussion.—(1) Which do the buyers in your section prefer, hand- or machine-picked peanuts?

2. What is the customary charge for picking peanuts in your section?
3. How many of the local farmers own pickers?
4. How many bags or pounds are considered a good day's picking?
5. What disposition is made of the peanut vines on local farms?
6. How many men are required to operate a peanut picker?
7. Calculate the costs of hand picking; of machine picking when you own a machine.

Activities.—Time yourself and others while picking peanuts or threshing them in different ways. Compare different lots in grade, purity, or cleanliness.

Fig. 155.—Instructor and student examining peanuts being cured in stack. (High School, Disputanta, Va.)

Formerly the entire peanut crop was picked by hand. This was a very laborious and slow method of picking and in recent years machines have been developed to perform this operation successfully. Buyers now generally prefer machine-picked peanuts.

Machine Picking.—After peanuts have cured in the stack for from three to six weeks they are ready for picking. The picker is generally placed in a mid-point in the field and the stacks of peanuts hauled to it on dump-carts or cart frames made especially for this purpose. Pickers are generally operated by gasoline engines and from four to five men are required to handle the various operations, including hauling and bagging (Fig. 156).

The machine pulls the nuts from the stems and vines, discharges the hay without having damaged it greatly, and separates dirt, trash and sappy peanuts from the marketable peanuts. The number of peanuts that can be handled in a day varies with the size of the machine and the management. An average of 350 bushels is considered a good day's work. The peanuts are bagged at the machine, a standard bag holding about 120 pounds of Spanish peanuts, and from 90 to 100 pounds of the larger varieties.

After bagging the peanuts are hauled to barns or storage houses and are generally stored until placed on the market. The vines are either

FIG. 156.—Picking or threshing peanuts with machinery. (Benthall Machine Co., Suffolk, Va.)

stacked in the field, stored in barns or in some cases scattered back on the land.

Gleaning with Hogs.—In many sections the hogs are then turned into the field. They use to advantage the peanuts that have been left in and on top of the ground during harvesting and picking. If the soil is heavy and the hogs are allowed to root up the fields in wet weather some difficulty will be experienced in putting the land in shape for the succeeding crop. This custom practically prevents the use of a winter cover crop and some farmers would rather have the cover crop than save the peanuts.

Job 10. Marketing Peanuts

Conditions Usually Found.—(1) Some farmers sell their peanuts through coöperative associations while others dispose of the entire crop through independent buyers. (2) A great many farmers "play" the market by storing their crops, hoping for a rise in price.

Aims.—(1) Farmers should become acquainted with the principles underlying coöperative marketing and should realize the advantages and disadvantages of this method of selling. (2) Considerable variation in price occurs for the different

grades of peanuts and the pupil should realize that quality and not "playing the market" largely determines profits.

Problems for Study and Discussion.—(1) How many of the farmers in your community sell their peanuts coöperatively?
2. How many farmers store their crop and sell later in the season?
3. Do many of them suffer loss during storage? Why?
4. What standards or grades are set up by the local buyers in your community?
5. What grades are produced locally?
6. How long has the coöperative organization been in existence in your section?
7. Get opinions of growers regarding best methods of marketing.
8. What do they think of holding for higher prices?

Activities.—Graph peanut prices for the last five years. Show on the same graph the yields for each year either for your region, or for the state or whole country.

Coöperative marketing organizations handling peanuts are in operation in several sections in the South. The grower must decide as to whether he will market through an association or sell to an independent company. A good many farmers have profited in the long run by marketing through a coöperative association, although they generally receive payments over a period of several months rather than receive the full cash price at the time of marketing.

When to Sell.—In deciding when to sell one must bear in mind the fact that considerable loss is often sustained in storage, on the average farm, from rats, mice, and the shrinkage in weight due to the curing of the peanuts. Storage houses can be made rat-proof without a great deal of trouble and this is found to be a wise precaution. The loss in weight from evaporation or drying varies. This should be considered in determining whether to sell at the price offered at picking time.

Prices.—Buyers pay good prices for good-quality, clean, bright peanuts. The production of this type of marketable product has not received sufficient attention.

Job 11. Keeping Accounts and Interpreting the Results of the Peanut Enterprise

Conditions Usually Found.—(1) Many farmers do not keep accurate records of the cost of producing peanuts. (2) When records are kept, the interpretations of the results are often misleading.

Aims.—(1) The student should learn accurately to close a set of cost accounts on the peanut enterprise. (2) He should also learn that one of the most important operations in growing peanuts is the analysis of the results of the enterprise.

Problems for Study and Discussion.—(1) How many farmers in your section keep accurate records on the cost of producing peanuts?
2. What items of cost should be considered in keeping records on the crop?
3. Who is the most successful peanut grower in your section?
4. How did you arrive at this conclusion?
5. What practices appear to have the most weight in determining the success or failure of the enterprise in your section?
6. What can you learn from studying the closed accounts of the peanut enterprise?
7. Ask growers to help you fill a record of the costs of self-labor, hired labor and horse-labor.

Records on costs, such as seed, fertilizer, use of machinery, hired labor, self-labor, horse-labor, rent of land, and cost of bags, should be kept. The money secured from the sale of peanuts and hay should be recorded. It is then comparatively easy to close the books on the enterprise. This is a very interesting operation and one that will show accurately whether or not we have been conducting a profitable enterprise. (See forms in corn enterprise.)

Below is the summary sheet of a five-acre (large-variety) peanut enterprise.

	Charges	Credits
By 6000 lbs. of peanuts at 5½ cts.		$330.00
" 5 tons of hay (inferior)		25.00
" 200 lbs. of pork, from peanuts left in field		16.00
		$371.00
To rent of 5 acres of land	$ 25.00	
" seed peanuts,	14.00	
" 2500 lbs. of lime	15.00	
" 1500 lbs. of acid phosphate	14.00	
" 65 peanut bags,	16.25	
" 200 hired man-hours @ 20 cts.	40.00	
" 300 horse-hours @ 15 cts.	45.00	
" 200 self-hours @ 15 cts.	30.00	
" rent of machinery (picking)	18.00	
	$217.25	$371.00
		$217.25
Net profit (difference between total charges and credits)		$153.75
Paid self for labor		$ 30.00
Total labor income (net profit plus paid self for labor)		$183.75
Labor income per hour		$ 00.92

If several such records can be secured it is very interesting to analyze and compare the different enterprises. Differences will be found in cost per acre, profit per hour, profit per acre, amount and kind of fertilizer, time of planting, and time of harvesting. This affords an excellent opportunity for studying carefully the practices followed by the most successful growers and will also show rather conclusively just where the less fortunate growers failed.

Things to Make at Home.—Device for stripping peanuts from roots; mount rotating box or barrel for polishing the peanuts.

References to State Bulletins.—Va. 218, 229; Ga. 270; Miss. 208; S. C. 45.

SOYBEAN AND COWPEA ENTERPRISES

By Walter S. Newman

Analysis into Jobs.—The following are the main jobs for the growing and disposing of soybeans and cowpeas. References are made to Farmers' Bulletins. See also *The Soybean* by Piper and Morse.

1. Determining the value of growing one of these crops. 973, 1148.
2. Choosing the variety. 886, 1148.
3. Preparing the soil and planting. 921, 973, 1148.
4. Fertilizing the crop. 973, 1148.
5. Cultivating the crop. 973, 1148.
6. Harvesting for hay and for seed. 886.
7. Marketing seed and utilizing hay. 973, 1153, 1265, 1308.
8. Closing accounts and interpreting results of the enterprise. 511, 572, 782, 1182.

Job 1. Determining the Value of Growing One of These Crops

Conditions Usually Found.—(1) Many farmers who could use these crops successfully do not appreciate their values. (2) The production of these crops for seed and their utilization as hay crops are making them profitable for a great many farmers.

Aims.—(1) The student should learn the value of these crops for green manure, for hay, and for seed production. (2) He should be able to decide which of these crops is best suited for his home conditions.

Problems for Study and Discussion.—(1) How many farmers in your section grow these crops for green manure; for hay; for seed?
2. Which is most popular as a crop to be turned under to improve the soil?
3. Explain how they fit into the general farming scheme followed in the community.
4. What do farmers say as to a market for the hay from these crops?
5. What does the seed cost per bushel?
6. Investigate the market for seed.
7. What are the yields where these crops are raised for seed in your section?

Factors.—In deciding whether to grow one or both of these crops several factors should be considered: purposes for which they are to be grown, climate, soil, labor required, machinery necessary and facilities for marketing or utilizing the product.

Uses.—Soybeans may be grown for hay, for silage, for seed; or the crop may be plowed under as a green manure. The value for hay makes it more profitable to feed the crop to livestock and return the manure to the land rather than to plow the crop under. In recent years the production of the crop for seed has become quite popular in some sections. This practice is becoming more and more general throughout the South.

VALUE OF LEGUMES

Secure nitrogen from air
Build soil fertility
Increase other crop yields
Improve quality of hay
Supply protein feed
Make greater yields of hay
Provide better pasture
Add organic matter

Cowpeas, likewise, are grown for hay, for silage, for seed, and for use as a green manure. A few varieties are grown for table use, but this is not practised extensively. The crop has not been as extensively grown for seed as soybeans, although this is a profitable practice in certain areas. Cowpeas are generally grown for hay and for green manure.

Climate and Soil.—The cowpea crop is suited to warm weather, and is very susceptible to frost. Cowpeas will grow on a wide range of soil types and produce a good growth on rather poor soils. Their ability to grow on sour soils makes them a very valuable legume to many farmers.

Soybeans are also suited to warm weather, but they can be grown from 200 to 300 miles further north than cowpeas. They withstand frost better than corn. Soybeans can stand more drouth than either cowpeas or corn and appear to be less sensitive to excessive moisture. The crop does not yield so well as cowpeas on very poor soil, but is a better crop on fairly rich soil.

Labor Required.—A summary of records of students of vocational agriculture in Virginia shows that when these crops are raised for hay approximately 25 to 30 man-hours and the same number of horse-hours are required per acre. To produce the crop for seed, from 40 to 45 man-hours and from 45 to 50 horse-hours are required per acre. When soybeans are grown with corn and hogged-off, very little more labor is required than is demanded by the corn crops. When grown for hog pasture about 20 man-hours and 30 horse-hours are required.

Machinery Used.—The ordinary hay-making machinery is used in harvesting the crops for hay. When grown for hay the crop is generally planted with a grain drill. A one-row or two-row planter is used in planting the crop for seed and sometimes for hogs. Grain threshers are often used in threshing the seed, although improved separators are on the market. In producing the seed in large quantities a cleaner should be used to rid the seed of chaff, stems, and gravel.

The yields of hay from these crops vary with the fertility of the soil and climatic conditions. From 1½ to 3 tons of soybean hay are generally secured per acre; the yields of cowpea hay are from 1 to 2 tons. In the soybean seed-producing sections from 15 to 20 bushels of seed are considered good yields. At these rates of yield a net profit of from $25.00 to $35.00 per acre may be expected if the product is sold for seed. When soybeans are sold for grinding purposes they generally bring from $1.25 to $1.50 per bushel. Cowpeas are more difficult to raise for seed than soybeans. The yield is generally lower and the crop is more difficult to harvest.

The Crops Compared.—Soybeans are generally recommended in preference to cowpeas for hog pasture. By raising different varieties of soybeans of early, medium and late types, an excellent hog pasture may be arranged. South Carolina reports, "pork produced on soybean pasture plus 2 per cent of corn shows a cost of $5.07 per hundred, while pork from corn and tankage costs $9.24 per hundred."

Both of these crops are excellent soil builders. When turned under, the amount of nitrogen they add to the soil per ton of growth is 58 pounds for soybeans and 45 pounds for cowpeas. Both are very good green manures. Owing to the demand for soybean hay and the fact that cowpeas generally give a better yield on poor land, cowpeas have been used for turning under to a greater extent than soybeans. When the crop is cut for hay and the sod turned under, from 15 to 25 per cent of the nitrogen in the crop is returned to the soil.

Soybean hay is easier to cure than hay from cowpeas. Both hays when properly cured are relished by most types of livestock. Perhaps the best results are obtained when the hay is fed to dairy cattle.

Job 2. Choosing the Variety

Conditions Usually Found.—(1) A large number of different varieties of soybeans and cowpeas are often grown in one section. (2) Often, in selecting the variety, very little attention is paid to the demands of the markets and to the purpose for which the crop is to be grown.

Aims.—(1) Growers should learn what varieties will give best results for their conditions. (2) They should realize that high-grade seed of an adapted, high-yielding variety is a profitable investment.

Problems for Study and Discussion.—(1) What varieties of soybeans and cowpeas are grown for hay in your section?

2. To what extent are these varieties grown from purebred or certified seed?
3. To what extent is the production of either of the crops for seed practised by local farmers?
4. What varieties are grown for seed?
5. How many farmers follow the practice of using either crop for hog pasture?
6. From what sources are soybean and cowpea seed secured by local farmers?

Activities.—Collect seeds of all varieties possible. Tabulate names, showing purpose, yields, earliness, cost of seed.

Local Varieties.—A very large number of different varieties of soybeans and cowpeas have been tested in different sections of the country and several varieties have been found that are adapted to each different section. New varieties are constantly being introduced, however, and the prospective grower should consult the findings of the nearest experiment station in order to be sure to select a variety that is well adapted.

Hay and Forage Varieties.—The following varieties of soybeans appear to have given the best results for the production of hay: Laredo, (Fig. 157) Virginia, Otootan, Wilson, and Biloxi. For hogging down there are many varieties used, among which Black Eyebrow, Ito San, Haberlandt and Mammoth Yellow give a very good combination for long

Fig. 157.—The Laredo variety of soybeans is growing in popularity. (F. J. Mitchell, Ark.)

season grazing. The time required for the different varieties to mature varies quite widely and the grower should familiarize himself with these characteristics before choosing the variety.

Varieties of Cowpeas.—Some of the cowpea varieties that have given good results for seed are Groit, New Era, Arlington, Whippoorwill, Red Ripper and Early Black. The varieties generally looked upon as best for hay are Brabham, Monetta, Iron, Wonderful, Black, and Red Ripper. Groit, Brabham, New Era, Whippoorwill and Iron might also be classed as general purpose varieties.

The growing of these two crops for seed has increased rapidly during recent years. This has resulted in the lowering of the cost of seed, and in some cases the quality of the seed has also been lowered. High-quality

purebred or certified seed (Fig. 158) of almost any variety may be secured and only such seed should be used. The cost per bushel of high-grade seed is very little more than that of ordinary seed and the yields and profits are from 10 to 30 per cent higher when using purebred varieties.

Job 3. Preparing the Soil and Planting the Crops

Conditions Usually Found.—(1) In some sections not enough attention is given to the preparation of the seed bed and maximum yields are not secured. (2) Considerable variation occurs in the rate and methods of planting.

Aims.—(1) The student should learn the importance and methods of properly preparing the soil. (2) He must become familiar with the approved methods and rates of planting for the variety he is to grow.

Problems for Study and Discussion.—(1) What crop generally precedes cowpeas and soybeans in your section?

2. How do the local farmers prepare the soil for these crops? Suggest improvements.
3. What are the proper times for planting these crops in your section?
4. What rate of seeding gives best results for the varieties grown locally?
5. To what extent is broadcasting by hand practised in your community?
6. Describe row planting and give distances.
7. Compare depths of planting and methods of covering.
8. What implements are used for planting?

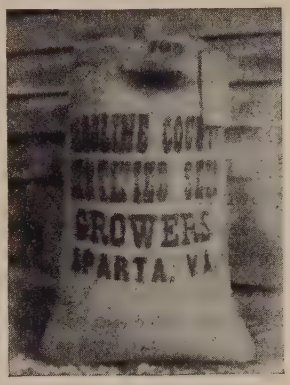

Fig. 158.—The Caroline County (Va.) Association sells all certified seed in branded and sealed bags. (Sparta, Va. H. S.)

As a rule the best preparation for planting these crops consists of flat-breaking the land and disking thoroughly so as to crush all clods. However, when the soil is not hard, disking sufficiently to put the surface in good tilth is all that is necessary. The seed bed should be light, loose and mellow on top but firm and fairly compact underneath. A smooth seed bed is very essential in securing a uniform depth of covering the seed and this is a potent factor in obtaining good yields.

Rows vs. Broadcasting.—On most soils it is advisable to plant these crops in rows, and cultivate rather than broadcast the seed. Cowpeas are often sown broadcast and good results are thus secured on fairly rich soil, not badly infested with weeds.

On soil of ordinary fertility where the crops are grown for hay the rows should be just far enough apart to permit cultivation. The rows should be farther apart on rich than on thin soil. More space should be allowed between rows when grown for seed than when hay is to be produced. Distances between rows vary from 24 to 36 inches and in the drill from 2 to 4 inches. With small-seeded varieties it is recommended that from 1 to

1½ bushels of seed be used per acre when the crop is sown broadcast and from ¼ to ⅓ bushel when seeded in rows 24 to 36 inches apart. The large-seeded varieties require from 1½ to 2 bushels for broadcast seeding and from ⅓ to ½ bushel for planting in rows.

When planting the crops for hay an ordinary grain drill is often used, enough of the holes being closed to secure the desired space between rows. For the production of seed crops, one-row or two-row corn planters with soybean plates may be used. Care should be observed to secure a uniform depth in planting as poor yields will result from planting too deep. From 1½ to 2 inches in heavy soils and 3 inches in light soils are generally recommended.

Planting with Corn.—It is a practice in many sections to plant soybeans and sometimes cowpeas in the rows with the corn crop. Several states report decreases in the yield of corn when this practice is followed, but this is generally offset by the yield of soybeans. As a balanced ration for hogs, or to improve soil, the mixture of corn and soybeans is generally advantageous.

Planting at the Right Time.—As a rule, the usual time for planting corn is satisfactory for seeding soybeans and cowpeas. If they are planted too early they may be damaged by late spring frost, while if planted too late the yields will be lowered. The purposes for which the crops are grown determines to some extent the time of planting.

Inoculating the Crop.—In many sections there is no apparent need for the inoculation of either of these crops. Larger yields are often secured when inoculation is practised and a well inoculated crop will derive more nitrogen from the air than one that is not well supplied with nitrogen-fixing bacteria. We must also realize that a well-inoculated crop will take less nitrogen from the soil than one that does not secure most of this plant food from the air.

Job 4. Fertilizing Cowpeas and Soybeans

Conditions Usually Found.—(1) These crops are grown for several different purposes and consequently the method of fertilization varies.

Aims.—(1) Growers and students should know what plant foods give best results when applied to these crops. (2) They should know whether the application of fertilizer should be made directly to the crop or to the preceding crop.

Problems for Study and Discussion.—(1) What plant foods are generally lacking in the soils in your county?

2. What elements should be present in the soil in available form to insure good yields of these crops?
3. Why should complete fertilizers seldom be applied to these crops?
4. What is the approved local method of fertilizing these crops when grown for hay? When grown for seed?
5. What form of phosphoric acid would you apply in your region? Of potash?

Fertilizer from the Preceding Crop.—When these crops are grown for catch crops or for hay, on fairly rich soil, additional fertilizer is not usually applied. Often it is more profitable to apply the fertilizer to the preceding crop in the rotation.

Supplying Mineral Fertilizers.—These crops are heavy feeders on phosphorus and potassium, especially when seed is produced. A crop of one thousand pounds of soybean seed contains 13.7 pounds of phosphoric acid and 20.7 pounds of potash, as compared with 6.8 pounds and 3.9 pounds, respectively, in the same amount of shelled corn. For the production of hay and seed, on all but clay soils, it is commonly recommended that phosphoric acid and potash be applied to the crop. From 200 to 400 pounds of fertilizer containing from 10 to 12 per cent of phosphoric acid and from 4 to 6 per cent of potash is generally applied per acre. On clay and fairly rich soils, acid phosphate alone is the recommended fertilizer. These crops, being legumes, will ordinarily derive from the air enough nitrogen, if properly inoculated, to supply their needs. Fertilizers should be applied before planting and thoroughly mixed with the soil so as not to come in direct contact with the seed, as such contact may affect germination.

Job 5. Cultivating the Crops for the Production of Hay and Seed

Conditions Usually Found.—(1) Some farmers do not cultivate either of these crops when grown for hay. (2) Practically all farmers practise good methods of cultivation when growing these crops for seed.

Aims.—(1) The student should learn that cultivation of the hay crop will prove profitable. (2) He should realize the necessity of frequent, thorough cultivations when seed is to be produced.

Problems for Study and Discussion.—(1) To what extent do the farmers in your section cultivate when these crops are grown for hay?

2. What implements do they use?
3. Why is it so important to practise early cultivations for these crops?
4. What implements are generally used in cultivating when the crop is grown for seed?
5. When should the cultivations be discontinued?
6. Explain why cultivation is more important for seed crops than for hay crops.

Harrowing.—Growers of these crops, especially soybean growers, have found that cultivating is profitable work. The critical time in the growth of the plants is from the time the seed comes up until the branching of the plants takes place. The first cultivation can be given with a spike-tooth harrow. The teeth are set rather flat and the implement is run at right angles to the rows. This cultivation is given just as the plants are breaking through the soil, or before, and has proven beneficial regardless of whether the crop is sown broadcast or drilled in rows. The harrowing will aid in securing a better stand and will kill many weeds, thus resulting

in larger yields. One additional cultivation is often given the crop when grown for hay.

When grown for seed the crops are cultivated about as corn. The earlier cultivations should be deep and the later ones shallow, as advised for corn. Cultivations should continue until the plants are ready to bloom. If the grass and weeds are kept down up to this time, the plants will shade out the grass thereafter. Three to four cultivations are recommended in addition to harrowing. Extra care is necessary when cultivating these crops when grown with corn. They begin growing somewhat more slowly than corn and less soil can be thrown toward the plants, at the first cultivation, than when corn is grown alone.

Job 6. Harvesting the Crops for Hay and for Seed

Conditions Usually Found.—(1) Most farmers experience little difficulty in harvesting soybeans for hay, but the curing of cowpea hay causes considerable trouble. (2) Usually no particular difficulty is experienced in harvesting these crops for seed.

Aims.—(1) Growers should learn the proper time and method to employ in securing high-grade hay from these crops. (2) They should become familiar with the best method of harvesting for the production of seed.

Problems for Study and Discussion.—(1) Which of these crops is the easier to cure for hay?

2. At what stage in the plant's growth do the farmers in your section recommend cutting for hay?
3. What machinery is used in harvesting for hay?
4. How long should the hay be allowed to cure before being put into the barn?
5. How many farmers in your section practise harvesting these crops for seed?
6. What difficulties do they encounter in harvesting for seed?
7. How is seed threshed?

Activities.—Visit places where different methods of harvesting for hay and seed are in progress. Participate in these operations if possible.

Cutting.—Cowpeas should be cut for hay when the first pods begin to ripen and just before the leaves begin to fall. The best time for cutting soybeans is when the pods are well formed and the lower ones are filled. Generally at this time the lower leaves have begun to turn yellow. To delay longer will result in the loss of leaves and in woody hay. (Fig. 160.)

Curing.—Experience has shown that the most satisfactory way to harvest cowpea hay is to cut after the dew is off in the morning and allow the vines to lay in the swath until the leaves are wilted. When the leaves have wilted but have not become dry and brittle, the vines are raked into windrows. The hay is then ready to be placed in ventilated cocks. The old method of cutting the vines and allowing them to cure on the ground has proven quite unsatisfactory. Curing frames are usually three or four-sided pyramids made of timber or poles from four to six feet long, fastened at the top and held by cross pieces near the base. Hay cured on these

will as a rule be ready for stacking in from six to twelve days. Although soybean hay is easier to cure than cowpea hay, the same procedure is recommended. Neither of these crops should be cured on the ground because of loss of leafy material (Fig. 159).

Cowpeas for seed are usually cut when about three-fourths of the pods are ripe and before the first pods are shattered. When harvested in this way they can be threshed with a special bean-and-pea thresher, or with a grain separator whose cylinder is run at half speed while the other parts of the machine are operating at normal speed.

The production of soybeans for seed has become such a universal and popular practice that special machines have been built to harvest and

FIG. 159.—Such racks as these insure a good quantity of hay. (Virginia Experiment Station.)

thresh in one operation. A great many growers, however, are not using these machines and are harvesting the crop with mowers, often equipped with side-delivery attachments, and in some cases the ordinary wheat binder is used. Self-rake reapers have given good results, as the plants are bunched out of the way of the machine and team. Usually the best time to harvest, except when special harvesters are used, is when about three-fourths of the leaves have fallen and most of the pods have ripened (Fig. 160).

When the mower and self-rake reaper are used the plants are usually placed in cocks in the field and allowed to cure from five to ten days. After curing, the crop may be stored under cover to await threshing at a later

date, or it may be threshed directly from the field. When a very small acreage is grown, seed may be threshed with a flail. The most satisfactory and economical method is to use pea-and-bean threshers or the ordinary grain thresher, properly adjusted. The adjustments recommended for threshing cowpeas apply also to soybeans. It may be necessary to remove all or some of the concaves or to use a set of thin concaves to keep from splitting the soybeans (Fig. 161).

FIG. 160.—The proper stage for harvesting soybeans for seed (left) and for hay (right). (Va. Exp. Station.)

Hogging-off.—When the crops are hogged-down the pasturing may be done in the green stage; or the swine may be turned in when the soybeans are about mature, and as they shatter out they will be consumed by the swine. If care is used the crop may be lightly grazed in the green state and the hogs taken off at intervals. New shoots will put out and, in some cases, seed will form. When soybeans are grown with corn, some of the corn is generally harvested before the hogs are turned in to harvest the remainder of the corn and soybeans.

Job 7. Utilizing Hay and Marketing Seed

Conditions Usually Found.—(1) Most farmers feed these hays to good advantage to livestock. (2) The sale of high-quality seed for planting purposes is proving profitable to many growers.

FIG. 161

FIG. 162

FIG. 161.—Threshing soybeans. (U. S. Dept. Agr.)

FIG. 162.—Agricultural students recleaning certified Laredo soybean seed. (Gloucester Co., Va.)

Aims.—(1) The farmer should know the best method of disposing of and utilizing the hay from these crops. (2) He should learn how to prepare seed for market and how to market seed to best advantage.

Problems for Study and Discussion.—(1) How many tons of hay per acre of each of these crops are produced on the average farm in your section?

2. How many farmers sell some soybean or cowpea hay?
3. What prices are received?
4. What livestock make the best use of these hays?

5. How many of your farmers sell seed for planting purposes?
6. Locate a soybean mill within reach of your community.

Activities.—Make a table of the uses to which the product of each grower is put.

The Hays.—A comparison of the value of the various hays commonly fed shows that cowpea and soybean hay will exceed all others in the percentage of protein. Because of this fact and of the high fat content these hays should be widely used to replace a part of the high-priced concentrates often purchased by farmers. These hays will perhaps give best returns when fed to dairy cows and young dairy stock, but nearly all farm animals seem to relish them if they are well cured. Up to the present time there has been no great demand for these hays on city markets.

Cleaning Seed for Sale.—Soybean production for seed greatly exceeds the amount of cowpeas grown for this purpose. If soybeans are to be sold either to the mill or to the seed houses they should be carefully recleaned after threshing. There are various seed-cleaning machines on the market that will remove sticks, hulls, dirt and trash of all kinds (Fig. 162). If one of these machines is not available, the soybeans can be cleaned by winnowing or by screening through home-made screens.

Coöperative Selling.—The production of pure-bred, high-quality seed has proven quite profitable. An outstanding example of this is found in the case of the Caroline County Certified Seed Growers' Coöperative Association. An account of the operation of this association under the guidance of F. B. Cale, agricultural instructor, follows:

"During the spring of 1919 four boys of the vocational agriculture class of the high school, Sparta, Va., selected for their home practice work two acres each of Virginia soybeans to be grown and marketed for seed. The students realized that successful marketing was just as much a problem as successful production. As marketing was one of the jobs studied in the course they decided that they would pool their beans and sell coöperatively. With the assistance of the agricultural instructor and advertising in a farm paper, the beans were soon sold at a premium over the market price. From this small beginning a live association has developed. Today the association has 39 members; markets from 2500 to 3000 bushels of certified Virginia soybeans, 1500 to 2000 bushels of certified Abruzzi rye, and from 700 to 1000 bushels of certified wheat. The association has a wide reputation for producing and marketing high-quality seed.

"The present organization is incorporated and has a five-year contract with each member. The officers are president, vice-president and five directors. The directors elect the president and vice-president from their number. The association owns and operates a modern power cleaner and sells seed to wholesale and retail trade. A seed to retail trade is shipped

in new bags branded with the brand of the association and sealed with a patent seal. Seed in sealed bags is guaranteed to be as represented. The demand for seed so far has exceeded the supply.

"This association is a member of the Virginia Crop Improvement Association. This is a State organization with offices at Blacksburg, Virginia. Its object is to encourage the production and distribution of high-quality field seed. It sets certain high standards and all certified seed must meet these requirements. It employs men especially trained at the Agricultural College to inspect each crop in the field. The seed from this crop is then inspected in the bin after harvesting. If it meets all requirements, it is certified; and each bag shipped must carry the yellow tag of the association."

Job 8. Keeping Accounts and Interpreting the Results of the Enterprise

This job is handled in almost the identical way as the same job under peanuts. If the procedure suggested is followed for these crops, profitable information may be secured. See forms in corn enterprise.

References to State Bulletins and Circulars.—N. C. 241; S. C. 76; Neb. Circ. 121; Tenn. Circ. 13; Va. 235; Ark. Circ. 230.

ANNUAL LEGUME ENTERPRISES

By Walter S. Newman

Analysis into Jobs.—The following jobs include the growing of Canada field peas, vetches, lespedeza and field beans. References are made to U. S. Farmers' Bulletins. See also *Forage Crops* by Piper.

1. Determining the value of growing one of these crops. 690, 1143, 1253, 1509.
2. Planning for the Crop. 921.
3. Preparing the soil and planting.
4. Harvesting. 1265.

Job 1. Determining the Value of Growing One of These Crops

Conditions Usually Found.—(1) Some farmers grow these crops with great success and profit. (2) In some sections these crops are used to only a very limited extent and their use will improve the farming practices.

Aims.—(1) Farmers and students should learn the value and use of these crops. (2) They should be able to determine which are best suited to their regions and soil needs. (3) They should learn the details of management.

Problems for Study and Discussion.—(1) Which of these legumes are grown locally?
2. What uses are made of them?
3. What are the soil requirements of each?
4. Which gives the best results as a soil builder in your community?
5. Which are best suited to hot weather?
6. What market is there for the seed of any of these crops in your section?

Before deciding which of these crops to grow several factors must be considered. Perhaps the most important of these are purposes for which they are grown, demands as to soil and climate, machinery necessary, yields that may be expected, and demands of the markets.

Canada field peas and vetches are generally grown for hay and soil improvement. Lespedeza is grown for hay in a few sections, while in other regions it is pastured and used as a soil improver. Field beans, sometimes spoken of as white or navy beans, are grown almost entirely for seed.

Canada field peas love cool weather conditions. They are not profitably grown south of Kentucky and give greatest returns in the cool northern states and Canada. Winter vetch, however, is widely grown throughout the south as a winter annual. Summer varieties of vetch are grown in the Gulf States, particularly in Alabama. Varieties of field peas are gradually being adapted to regions farther south. Lespedeza requires a hot climate and a comparatively long growing season to mature. Field beans require a growing season free from frost from May 20 to September 15. At present

the production of this crop is largely confined to certain sections of the northern and northwestern states.

Vetches and Canada peas grow well on soils suited to barley and oats. Lespedeza thrives best on the alluvial soils of the Mississippi delta and on very fertile soils in other sections. It grows on poor soils but rarely makes a growth of more than six inches on such soils.

Ordinary hay-making machinery is used in harvesting these crops for hay. Field beans are generally cut with special harvesters and threshed with bean or grain separators.

The production of navy beans is proving profitable in the sections referred to above. Lespedeza-hay production is also a very practical enterprise where the crop produces sufficient growth to cut for hay. Canada field peas are not grown so extensively as vetches but make a good quality of hay when grown with other crops. In many instances they are used as green manure with splendid results.

Job 2. Planning for the Crop

Conditions Usually Found.—(1) Farmers generally plan rather carefully for these crops some time in advance of planting.

Aims.—(1) Growers should realize the necessity of careful planning for these crops. (2) They should learn the sources of good seed and the rates of seeding recommended.

Problems for Study and Discussion.—(1) What varieties of these crops are grown in your section?

2. To what extent are these crops grown alone in your county?
3. Why do your neighbors grow these crops?
4. Where can you secure good seed?
5. To what extent are fertilizers applied to these crops in your region?

Activities.—Make a collection of annual legumes and their seeds. Include their root systems and nodules.

Varieties.—Canada-pea seed is grown chiefly in Michigan. There are several strains which vary in the size of seed, the large being more suited for canning. Vetches are of two main varieties, winter and spring. Winter vetch is suited only to fall sowing. Spring vetch is suited for sowing in early spring and will not withstand the hot weather of middle summer (Fig. 163). The field beans generally grown are the large white, small white, and the Red Mexican or Red Minor.

Rates of Seeding.—Twenty to thirty pounds of vetch seed are generally sown with three to four pecks of rye or wheat and six pecks of oats when any of these combinations are used. Wheat and oats make better hay, but rye is generally used when the crop is to be turned under. Some companion crop should always be used to hold the trailing vines from the ground. Canada peas with small grains require about one bushel of seed of each for the mixture per acre. Lespedeza generally reseeds itself,

but when sowing is practised about 25 pounds or one bushel of seed in the husk is required per acre. About one-half bushel of small-seeded field beans is required to seed an acre.

Fertilizers.—These crops will respond to applications of lime if no lime has been recently applied to the field. None of them demand much lime; lespedeza least so. The soils on which lespedeza thrives are

Fig. 163.—Winter hairy vetch and rye are grown together for winter cover, for forage, or for green manure.

rich enough to make it needless to apply fertilizers. Navy beans are grown in the grain-producing areas and the controlling factor there seems to be the amount of organic matter in the soil. Field peas and vetches respond to the application of barnyard manure. If this is not available 200 pounds of acid phosphate and 25 pounds of potash per acre should be applied on soils of average fertility.

Job 3. Preparing the Soil and Planting

Conditions Usually Found.—Growers usually prepare a good seed bed and sow these crops properly.

Aims.—Students should understand the different methods so as to adapt them to the special crops and their local conditions.

Problems for Study and Discussion.—(1) How is the soil prepared for each of these crops grown locally?

2. What are the dates of sowing these crops in your section?
3. What methods of sowing these crops are followed?
4. What crops usually precede these special crops in your county?
5. How many of your neighbors cultivate these crops?
6. Give reasons for and against cultivating.

Preparing the Soil.—A good seed bed with a rather firm bottom and a loose surface is best for each of these crops. Preparation should be made as for small grains. Double disking with a heavy disk harrow is often practised when there is not time enough to plow and allow the soil to settle before planting.

Sowing.—When field peas and vetches are sown with small grains some broadcasting method may be used. With the field peas a good method is to drill the peas in one direction and sow the grain crosswise of this. Vetches for winter crops are generally sown later than July or August. Lespedeza is sown in early spring and is usually broadcast by hand or with a rotary seeder. Harrowing should be practised either before or after seeding to insure the seed entering the ground. This operation will not harm the nurse crop if one is used, provided the teeth of the harrow are slanted backwards.

Navy beans are ordinarily drilled in rows 28 to 36 inches apart. Grain drills with some of the shoes closed or one- or two-row planters may be used. If the soil is very weedy, the crop is sometimes planted in hills with a check-row corn planter, so that cultivation can be accomplished easily. Field beans should be planted after the danger from frost is past.

Harrowing.—All of these crops should be harrowed after sowing, and if conditions for germination are not favorable, two harrowings may be given. These will allow young plants to start ahead of the weeds. This is particularly important with those crops that are to be cultivated in rows.

Job 4. Harvesting

Conditions Usually Found.—The methods of harvesting vary widely with several of these crops.

Aims.—Growers should learn different methods so as to adapt them to local conditions.

Problems for Study and Discussion.—(1) Which of these crops are harvested for hay in your section?

2. What special difficulty do your farmers experience in curing these crops for hay?
3. Which of these crops are harvested for seed in your section?
4. Which are used for pasture?

Activities.—Collect samples of hay. Practise judging good and bad lots of hay and seed.

Harvesting for Different Uses.—When any of these crops or other mixtures are used for hay they are cut with a mowing machine, raked, and cured as are the grass crops. Vetch can be harvested for seed, threshed with its companion crop, and then the seeds of the two crops separated by machinery. Special equipment is often used when harvesting lespedeza for seed. This crop is often pastured and no attempt is made to harvest for either hay or seed.

Field beans are generally harvested with two-row machines. Curing is often accomplished by using small ventilated stacks. After the vines and pods have thoroughly cured, they may be threshed or stored under cover for threshing at a future date. Considerable care must be exercised in threshing as the beans split easily.

Soil Improver.—Lespedeza, except in a very limited area, does not make a heavy growth and is not so popular for turning under as vetch and field peas. Both of the last-mentioned crops are excellent for soil building and should be used as green manures to a much larger extent.

Things to Make at Home.—Bins for storing seed.

References to State Bulletins and Leaflets.—Tenn. 123; Penn. Leaf. 15; Ga. 117.

IRISH POTATO ENTERPRISE

By James K. Coggin, B.S., M.S.A.

Assistant State Supervisor Agricultural Education, North Carolina

Analysis into Jobs.—Following are the jobs to be undertaken in an Irish potato enterprise. The references in the list are to U. S. Farmers' Bulletins. See also potato books by Stuart and by Gilbert.

1. Determining possibilities with Irish potatoes. 1190, 1205.
2. Choosing soil; deciding acreage. 1190, 1205.
3. Growing cover crop; providing organic matter. 515, 579, 967, 1142.
4. Buying and mixing fertilizer. 1205.
5. Choosing variety; securing seed. 1190, 1205, 1332, 1367, 1436.
6. Preparing the soil. 1190, 1205.
7. Treating and cutting seed potatoes. 1190, 1205.
8. Planting and fertilizing. 1190, 1205.
9. Cultivating. 1190, 1205.
10. Controlling insects and diseases. 1034, 1190, 1349, 1367, 1436, 1462.
11. Harvesting and grading. 1050, 1091, 1316, 1332.
12. Storing potatoes. 847, 1317.
13. Marketing the crop. 753, 1050, 1091, 1316, 1317, 1332.
14. Keeping records. 511, 572, 782, 1172.

Job 1. Determining the Possibilities with Irish Potatoes

Conditions Usually Found.—(1) Both early and late crops are successfully grown commercially in sections of most of the southern states. (2) A large percentage of the crop is shipped to northern markets. (3) The bulk of the potato crop is grown in more or less well-defined areas where the soil and climatic conditions are favorable, and near the large cities.

Aims.—Students should learn the factors influencing the successful production of potatoes, such as yields, labor and capital involved, market conditions, and danger of losses.

Problems for Study and Discussion.—(1) How many bushels of potatoes are grown in your home county?

2. How many bushels of potatoes are grown in your state?
3. How does the production in your state compare with the production in other states?
4. Name the leading states in potato production.
5. What are your nearest accessible large potato markets?
6. What is the leading state in the South in potato production?
7. Describe the climatic conditions most suitable for potatoes.
8. In choosing a project crop give reasons for and against growing Irish potatoes in your locality.
9. In what sections of Virginia, North Carolina, and other southern states is the late crop grown?
10. In what regions of the same states is the early crop grown? Account fully for this.

11. In accompanying table, compare the bushels per acre for your state with other states.
12. What would be the value of an acre of potatoes in your best market?

Activities.—Using an outline map of the United States, color those regions of the South where the bulk of the potato crop is grown.

Fig. 164

Fig. 165

Fig. 164.—World's production of potatoes. Percentages by countries. 1922–1926 inclusive.
Fig. 165.—Production of potatoes in the United States. Percentages by states. 1922–1926 inclusive. (Chamberlain's Geography.)

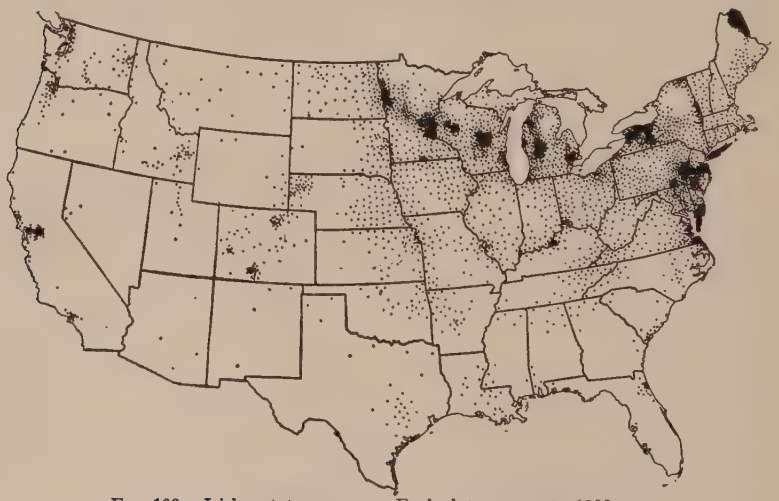

Fig. 166.—Irish potato acreage. Each dot represents 1000 acres.

Irish Potato Regions.—Maine has frequently led the states in Irish potato production. Michigan, Minnesota, New York, Wisconsin and Pennsylvania are the other leading producing states for the country as a whole. (Figs. 164, 165 and 166).

Virginia leads the southern states in production. Following are the acreage and production for twelve southern states. (U. S. Yearbook.)

	Number Acres	Production bu.	Bu. per Acre
Virginia	134,000	11,658,000	87
North Carolina	74,000	7,400,000	100
South Carolina	29,000	3,219,000	111
Oklahoma	43,000	2,838,000	65
Florida	24,000	2,832,000	118
Tennessee	35,000	2,730,000	78
Louisiana	36,000	2,196,000	61
Texas	30,000	2,100,000	70
Alabama	29,000	2,030,000	70
Arkansas	32,000	1,920,000	60
Georgia	19,000	1,197,000	63
Mississippi	12,000	852,000	71

Labor and Capital Involved.—The greatest labor with this crop is marketing. Implements are used which greatly reduce other lines of labor. With the early market crop, harvesting must be done rapidly in order to obtain the best prices. The late crop may be harvested more leisurely.

The beginner should calculate the amount of capital required to finance his crop. Besides labor, the greatest expenses are for seed and fertilizer.

Losses in this enterprise may be easily prevented so far as insects and diseases are concerned. Growers seldom experience any other losses. Market conditions may be such as to reduce profits to the minimum, but the crop may be used for livestock if necessary.

Yields.—From a table of acreage and production in a U. S. Yearbook the average yield per acre may be calculated for any state. Compare the average in your state with the best yielding states of the country. Compare local yields with your state average (Fig. 167). Yields are often reduced when the crop is harvested for early market as much of the crop is sold in the "green" stage to meet better prices (Fig. 168).

Job 2. Choosing Soil. Deciding Acreage

Conditions Usually Found.—(1) Many growers select soils and fields infected with diseases or otherwise unsuited to this crop. (2) In commercial regions suitable soils are usually chosen. (3) The best potato growers do not plant larger acreages than they can well tend.

Aim.—Students should decide the acreage and field for potatoes on the home farm. They should know what soils are best for this crop and how to improve them.

Problems for Study and Discussion.—(1) Make a survey of your local community to determine the acreage and size of fields planted to potatoes.

2. What types of soils give greatest yields?
3. How well are your local soils suited for growing a large acreage?
4. What are the transportation facilities and freight rates from your shipping point to terminal markets?
5. What is the average yield in bushels per acre for potatoes on local soils?

FIG. 167

FIG. 168

FIG. 167.—A vocational agriculture boy of the Poplar Branch High School and his teacher inspecting the potato project just before harvesting, judging maturity for early potatoes.

FIG. 168.—Wentworth Gregory, vocational student in North Carolina, moving his potatoes from the field to the shipping point. The yield is good in spite of an early harvest.

6. What is meant by a warm soil? Why are warm soils preferred for the early potato crop?
7. To which crop, early or late, are your soils best suited?
8. What is the danger to Irish potatoes from having the soil infected with scab or other soil troubles?

Activities.—Make laboratory studies of local soils. Include sieve analyses; percolation trials; tests for organic matter.

Selecting Soils.—The Irish or white potato will grow in almost all types of soil in the country. Certain types, however, are best suited for heavy yields and for commercial areas, where the ease of digging is a big factor. The potato crop in the southern states may be divided into three general crops, the early crop, the late crop—both grown for commercial purposes—and the garden crop grown by farmers for their home use. The early crop is largely grown in what is known as the Tide-Water section or Coastal Plain of eastern Virginia, North and South Carolina, and Florida. The late crop is grown in the mountainous or colder areas over the southern states. In the higher altitudes, as in western North Carolina and eastern Tennessee, certified potatoes are grown for seed and sold to the growers who plant early crops. This is a new development in seed supply.

Generally the types of soil best suited to potatoes are sandy, gravelly or shaly loams. Very heavy soils are objectionable for the reason that potatoes will not dig clean; the light sandy soils are poorest owing to the lack of sufficient organic matter and moisture. Muck and peat soils in certain restricted areas are excellent, but produce a potato less rich in starch. Regardless of the type of soil, for best yields only the deep, loose, friable and well-drained soils with a bountiful supply of organic matter and moisture prove satisfactory.

Deciding Acreage.—Beginners and others should not grow more than they can properly attend. If other farm work interferes, a large field may be neglected when insects and diseases or weeds attack the crop. Find the average acreage in your region before deciding on your own.

Potato Rotations.—Where three-year or four-year rotations are followed, try to have the potato crop follow a sod crop of grass or clover if possible. A crop of cowpeas or soybeans grown the season before Irish potatoes, leaves the soil in good physical condition and supplies nitrogen also. In the extreme South bur clover, crimson clover, or sweet clover may be grown just before Irish potatoes in the rotation.

Job 3. Growing Cover Crop; Providing Organic Matter

Conditions Usually Found.—(1) The importance of organic matter in soils for potatoes is often overlooked by growers. (2) The open sandy soils often lack humus and consequently are low in moisture. (3) Too many growers fail to grow cover crops.

Aims.—(1) Growers should learn the importance of cover crops and organic matter for Irish potatoes. (2) They should learn the best methods of growing cover crops and providing organic matter for the region in which they live.

Problems for Study and Discussion.—(1) Study local soils and ask growers regarding needs of organic matter.

2. How does a large amount of humus in soil aid in retaining a large amount of moisture?

3. What are the benefits of a winter cover crop to soils of your region?
4. On what type of soil is a cover crop most beneficial? Why?
5. What are the crops planted in your region for winter soil protection?
6. Make a list of those planted and tell which you consider best and why.
7. What are the chief objections to a cover crop on the soil prior to a crop of early potatoes?
8. Work out a cropping system which will supply green manure or organic matter for the potato crop.
9. When should the cover crop or other green manure be turned under for potatoes? Give reasons.
10. List the insects which do most injury to the potato following an old sod crop.

The chief benefits of a winter cover crop in the South are listed in the corn enterprise.

Green Manuring.—Soil for potatoes needs much organic matter. If old sods are turned under they provide this need, but often cause bad attacks of grub worms in the tubers. If a one-year legume crop or a winter cover crop is used as green manure there is little danger from such insects.

In the South the early potato crop requires that the soil be ready for planting in late winter or very early spring. This lends a difficulty to the plan of using a winter cover crop as green manure preceding early potatoes. If, however, the cover crop is started in July or August it may well make an abundance of growth for green manure and may be turned under in mid-winter in time to prepare the soil for potatoes.

GREEN MANURE

Produces humus
May add nitrogen
Unlocks plant food
Is cheapest plant food
Improves soil structure
Airs and warms soil
Regulates moisture
Retards leaching
Reduces washing
Favors soil organisms

Barnyard manure, if fresh when applied to a potato field, is liable to cause scab disease on the tubers. If there is a good supply of barnyard manure available for use on the soil it should be applied to the field on some other crop in the rotation. It can then be well rotted before the potatoes are planted. Manure is one of the best forms of organic matter and fertilizer for potatoes.

Job 4. Buying and Mixing Fertilizers

Conditions Usually Found.—(1) Farmers usually buy ready-mixed fertilizers. (2) Heavy applications are made to the potato crop, especially in the commercial areas.

Aims.—The fertilizer needs for potatoes should be learned by students. They should know the savings due to home-mixing.

Problems for Study and Discussion.—(1) What are the fertilizer formulas used for the various crops in your community?

2. Explain the meaning of the following formulas: 8–3–3 and 8–4–5. Which is the higher grade?
3. Why are not all 8–3–3 formulas of equal value? Explain.
4. What is a "complete" fertilizer?
5. Explain the effect of each ingredient upon plant growth: nitrogen; potash; phosphoric acid.
6. What, in general, would be the difference in fertilizer requirements for an open sandy soil low in humus and moisture content and for a loam well filled with humus and soil moisture? Justify your answer.
7. List two carriers of potash, three of nitrogen, and three of phosphoric acid suitable for potatoes, giving the percentages of the most valuable elements.
8. What is the average amount in pounds of fertilizer applied per acre for potatoes in your section? How much does this amount (ready-mixed) cost at present local prices?
9. Calculate the saving per ton by home-mixing.
10. Calculate the cost of the plant-food elements removed by an average production of potatoes for your community.
11. What is meant by organic forms of nitrogen? Inorganic forms? What is meant by an available plant food?

Fertilizer Materials Removed.—The average yield of potatoes in the southern states is about one hundred bushels per acre. This crop would remove from the soil the following amounts of plant food: nitrogen, 20 to 24 pounds; phosphoric acid, 9 to 10 pounds; potash, 28 to 30 pounds. These ingredients could be returned to the soil by applying 135 pounds nitrate of soda; 50 to 60 pounds high-grade acid phosphate; and 50 to 60 pounds muriate of potash. Smaller yields remove less plant food but the same relative amounts.

Fertilizers.—The type of fertilizer best suited for the potato is governed by the type of soil in which the potato is planted. Potatoes yield well only in soils where there is a large amount of available plant food. Commercial growers usually make heavy applications of commercial fertilizer. The mixture 8–5–5 (N–P–K) is suited to many sections of the country. When barnyard manure or green manure is applied with an application of commercial fertilizer the amount of nitrogen in the commercial mixture should be cut down in proportion to the amount of manure applied. If a legume crop is plowed under this will also reduce the amount of necessary nitrogen to be applied from commercial sources. The amount of fertilizer to apply varies with the fertility of the soil. (See Appendix for amount of plant food removed.) Applications are usually made of from eight to fifteen hundred pounds per acre.

Applying Fertilizers.—When fertilizer is distributed in the furrow it should be well mixed in the soil to avoid injuring germination of the potatoes. An application of 500 pounds per acre can be made in the furrow. Very large applications should be spread broadcast.

Profits from Home-Mixing.—As potatoes require much commercial fertilizer the grower can save materially by buying the carriers of nitrogen, phosphoric acid and potash and either spreading them on the land separately or mixing them on a smooth floor before spreading. (See corn enterprise for method of mixing.) If large areas are grown the saving is greater than for small patches. The grower saves on freight and on quantity handled because no filler is used and because high-grade materials only are handled. He is able to buy exactly what his crop requires instead of buying what the commercial mixer wants to sell. (See table for mixing in cotton enterprise.)

Coöperative buying of fertilizer ingredients is frequently done by a group of growers pooling their orders. A farm organization may handle the business and obtain reduced prices.

Job 5. Choosing Variety; Securing Seed

Conditions Usually Found.—(1) Southern growers usually purchase their seed from northern growers for the spring crop. (2) The varieties selected depend upon the market demand in the commercial areas and the individual needs of the farmers.

Aims.—(1) The variety to select, and sources for securing seed should be learned by growers. (2) They should know the importance of careful selection.

Problems for Study and Discussion.—(1) What are the varieties commonly grown in your community?

2. What are the most popular varieties?
3. What are the characteristics of a good seed potato?
4. What would you look for in seed potatoes to avoid mixed varieties, diseased or "run-out" seed?
5. Under what conditions would you select seed from your own locality? Give reasons.
6. How many bushels of potatoes would you purchase to plant one acre?
7. What is meant by "certified seed"?
8. What are the advantages in growing certified seed?
9. When is it profitable to grow seed potatoes in the South? Justify your answer.
10. When is the best time to purchase seed potatoes?
11. What sizes of potato are best suited for seed purposes?
12. Why do growers not replant immature seed for the fall crop?

Activities.—Obtain good samples of as many varieties as are found in your region. Make comparative study of these.

Securing Seed Potatoes.—Most of the seed potatoes planted in the southern states are grown in the northern states. Southern seed have a tendency to "run out." Certified seed (Fig. 169) produced in the higher altitudes of western North Carolina and eastern Tennessee and other mountainous sections of the South are being used for planting and have proven satisfactory in recent years. Maine, New York, Minnesota,

Wisconsin and Michigan furnish the bulk of the potato seed for the South. Carload shipments are made during late winter and early spring (Figs. 169 and 170).

FIG. 169.—All potatoes fertilized and cultivated alike. On left is project of a vocational agriculture student. Potatoes on right belong to his father. The difference is that the boy used certified seed. His father did not.

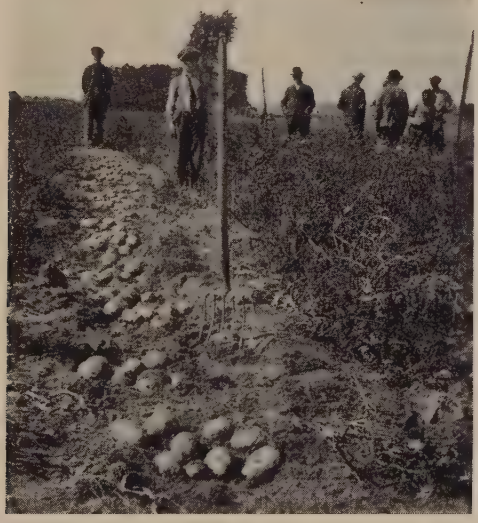

FIG. 170.—Vocational boys comparing hill yields in seed selection. (H. C. Moore.)

Why Irish Potatoes "Run Out."—Extensive experiments by the Minnesota Station (Bul. 197) lead to the conclusion that "running-out"

is caused by a disease called mosaic. This is not a spore disease but is carried in the sap of the plant. "Mosaic dwarf is perpetuated from year to year by planting tubers from diseased plants. It can be transmitted artificially by transferring the juice of diseased plants to healthy plants, and by grafting a diseased tuber on a healthy tuber. The disease did not spread through the soil when healthy and diseased plants were grown side by side in the same box and their roots allowed to intermingle. Field experiments with insect cages further indicate that infection does not occur through the soil. Healthy plants did not become infected when planted in soil which previously grew diseased plants. Infection of healthy plants in the field has been prevented by excluding from the plants insects which appear later than July 5th."

The only means of infecting plants, therefore, is by planting infected seed or by spreading from neighboring infected plants by insects. Mosaic causes the leaves to become mottled, from light green to yellow and in some cases to dark green. The disease works down the stem to the tubers and is carried over in the seed. Using such seed over and over again each year results in greatly diminished yields as shown in the following data from the Connecticut Station, (Bul. 107) giving bushels per acre from new and old seed.

New seed	250
One-year-old seed	196
Two-year-old seed	138
Three-year-old seed	163
Four-year-old seed	118

Good seed should be pure with respect to variety, and from healthy, vigorous and heavy-yielding plants. The tubers should be uniform in size and shape, from best yielding hills (Fig. 170) free from "small ends" and disease. Evidence of sprouting at planting time is a desirable characteristic.

Varieties to Select.—Probably the best procedure, in deciding the variety to grow, is to make a study of the varieties grown in the local community or those recommended by your state station to determine the variety yielding the highest value per acre. The Irish Cobbler, Triumph, Early Ohio and Spaulding No. 4 are the leading early commercial varieties. The last is very popular in Florida.

Fall Varieties.—More time may be allowed for the growth of the fall crop in southern states, but varieties that will mature in a short season must be used. In the above list the Triumph and Irish Cobbler are preferable to the others. Green Mountain is still popular in limited sections. Irish Cobbler is probably the most popular of all, because of its smoothness, shape, and keeping qualities.

Long season varieties are suited to the higher altitudes of the South, planted in spring and harvested in fall. Among the most suitable for this purpose are Burbank, Rural New Yorker, Money Maker and Green Mountain (Fig. 171).

FIG. 171.—Green Mountain potatoes fertilized with 1000 pounds 10–4–4 (N–P–K) plus 250 pounds nitrate of soda per acre. Certified seed were used. (Voc. Agr. Dept., Pleasant Hill, Tenn.)

Field Selection.—Seed should be secured from certified stock each year to obtain maximum yields. If the grower does save one generation

RELATION OF CERTIFIED AND NON-CERTIFIED IRISH POTATO SEED ON THE PERCENTAGE OF GERMINATION. AVERAGE HEIGHT OF PLANTS, PERCENTAGE OF MOSAIC PLANTS, AND YIELD PER ACRE*

(Miss., Circ. 60)

KIND AND SOURCE OF SEED	GERMINATION	AVERAGE HEIGHT OF PLANTS	MOSAIC PLANTS	YIELD PER ACRE		
				Tubers 2 or More Inches in Diameter	Tubers 1½ to 2 Inches in Diameter	Total
	Per cent	*Inches*	*Per cent*	*Bushels*	*Bushels*	*Bushels*
Non-certified Lot No. 1 Vicksburg, Miss.	90.56	10.01	68.07	36.81	58.98	110.70
Certified Wisconsin Eagle River, Wis.	99.72	13.18	2.78	83.84	86.11	186.37
Non-certified Lot No. 2 Jackson, Miss.	93.61	9.74	32.24	33.34	80.14	136.33
Certified Nebraska Alliance, Nebr.	99.17	14.49	2.52	91.51	96.88	204.62

* Average of three rows.

SUMMARY OF ALL TESTS OF CERTIFIED COMPARED WITH NON-CERTIFIED SEED, 1922–1925

(South Carolina, Bulletin 232)

YEAR	COUNTY	TOTAL YIELD CERTIFIED	TOTAL YIELD NON-CERTIFIED	INCREASE OR DECREASE OF CERTIFIED STAND
		bbls.	*bbls.*	%
1922	Georgetown	12.0	5.5	+ 25
"	Berkeley	69.4	45.5	+ 32
"	Spartanburg	68.5	57.9	+ 9
1923	Spartanburg	62.0	55.6	+ .5
"	Charleston	57.8	54.2	+ 6.6
1924	Hampton	87.6	91.2	+ .6
"	Colleton	108.0	81.5	+ 9.5
"	Spartanburg	73.3	67.8	+ 4.8
1925	Georgetown	55.6	48.0	− .5
"	Hampton	16.5	15.2	+ 13
"	Hampton	17.7	11.2	− .1
"	Sumter	57.1	65.6	+ 13.5
	Average	57.1	49.9	

Difference in favor of certified seed 7.2 barrels per acre.

of home-grown seed, a good method is to go into the field at digging time and select seed from high-yielding hills free from mosaic. Seed from high-yielding hills tend to produce high-yielding hills the next year. Small potatoes are just as good as large cut potatoes of the same weight. It is a poor method to harvest the entire crop and then pick out the best potatoes for seed, as the best potatoes many times come from low-yielding hills.

Job 6. Preparing the Soil

Conditions Usually Found.—(1) Most growers prepare a good seed bed for potatoes. (2) Some soils are too shallow to allow deep plowing.

Aims.—It is necessary that students know the value of a deep, well prepared soil for Irish potatoes.

Problems for Study and Discussion.—(1) How should soil be best prepared for potatoes?

2. Name the kinds of implements or machinery used in the preparation of soil for potatoes in your community.
3. When is the best time to plow the soil, fall or spring? Discuss.
4. If the soil is prepared in spring how long before planting time should the preparation be made?
5. Give the advantages of deep plowing for potatoes.
6. What are the advantages of a rather loose soil for this crop? How is this best made?
7. Get opinions of farmers regarding ridging and level planting for early potatoes. For late potatoes.
8. What are the advantages of a bare-fallow period before planting the fall crop?

Preparing Soil for Early Potatoes.—For the early potato crop soil is usually plowed in the fall or early winter. If a winter cover crop is growing it may be plowed under in late winter or early spring. It should be disked before and after plowing. Fall plowing is advantageous for the reason that it will allow vegetable matter that is plowed under to be decomposed. It will also allow earlier planting which is desirable in order to get the potato crop developed to maturity for the earliest market when prices are highest. Soils plowed in the fall or early winter should be double-disked and smoothed with a spike-tooth harrow prior to planting.

Preparing Soil for Fall Crop.—Soil to be planted in late crops should be broken in the spring or early summer and kept mulched in order to insure a sufficient amount of moisture to supply the vines and young potatoes during the months of July and August. If manure is applied to either early or late crop it should be broadcast over the soil several weeks prior to plowing, to allow time for decay. A limited supply of well-rotted manure may be drilled in the rows and mixed with the soil before planting, with good results.

Ridging.—If soils are not well drained, ridging is sometimes practised for the early crop of potatoes. A turning plow or a ridging machine may be used just before planting. Beds are thrown up and then leveled on top with a planker, drag or roller. The potatoes are planted in a furrow in the ridge. Ridges are frequently made with the planter while planting. Ridging is probably becoming less popular, as potatoes suffer in dry weather in ridges.

Job 7. Treating and Cutting Seed Potatoes

Conditions Usually Found.—(1) Most large commercial growers treat their seed for scab before planting. (2) Many small growers and farmers fail to treat seed potatoes. (3) Scabby potatoes result from failure to treat seed. (4) Proper methods of cutting potatoes are usually practised by most farmers.

Aims.—(1) The best methods of treating seed for scab should be learned by students. (2) They should know the most economical and best methods of cutting potatoes to plant.

Problems for Study and Discussion.—(1) Inquire of farmers who grow potatoes in your community to determine the number and percentage who have trouble with scab disease.

2. What causes scab on potatoes?
3. How may it be controlled?
4. What is the approximate cost of treating five bushels of seed potatoes for the control of scab?
5. Describe in detail the best method of treatment.
6. What effect has seed treatment on yield per acre?
7. How should seed potatoes be cut for planting?
8. Discuss cut vs. whole potatoes for planting as affecting quality and size, and yield per acre.
9. What is a machine cutter and how does it operate?

10. How many bushels of potatoes are required to plant an acre?
11. How does the amount of seed affect the yield per acre?
12. At market prices, what would be the cost per acre for the seed? At minimum rate of planting? Maximum?

Activities.—(1) Practise selecting good seed potatoes. (2) Treat seed as directed. (3) Green-sprout seed. (4) Cut seed potatoes by hand or by machine. (5) Plant a part of the field with larger seed pieces than the remainder, to compare results.

Diseases Controlled by Seed Treatment.—Scab and rhizoctonia are tuber-borne diseases and may be controlled by proper methods of seed treatment so far as infection from the seed is concerned.

Black leg and other degenerate diseases such as leaf-roll, spindle tuber and mosaic are carried in the tubers and cannot be controlled, with present knowledge of these diseases, except in the field which is to produce the seed stock (Bulletin 176, Florida Station). Disease-free seed are recommended as far as possible.

Treating the Seed.—Where scab and rhizoctonia appear only on the surface of the tuber the following treatment proves an effective control. Four ounces of corrosive sublimate to 30 gallons of water; or one pint of formalin in 30 gallons of water, where the infection is very slight. Either may be secured from almost any drug store. Dissolve the material in warm water and add to the 30 gallons of water in a wooden barrel. Put a bushel or more of potatoes in a crate and dip for 30 minutes in the corrosive sublimate solution or 2 hours in the formalin solution and then spread out to dry. Strengthen or make up new solutions after ten bushels have been treated. Never cut the tubers before treatment. Potatoes are unfit for eating after dipping in corrosive sublimate; it is poisonous.

Cutting Seed Potatoes.—The common practice is to cut seed by hand, although automatic implements are replacing this method in the large commercial sections, because of the increase in cost of labor. This latter method is objectionable, however, in that it cuts many of the seed pieces with no vigorous eye or no eye at all.

The first essential in cutting is to divide the potato in such a way as to ensure one strong eye or more on each piece. The seed pieces should be blocky, as they are then more easily handled in the planter, and are less likely to dry out under unfavorable weather conditions.

When to Cut Potatoes.—If the potatoes are cut long before planting, as is the practice with some of the larger growers, they should not be stored in bulk before drying because they will heat. A good method is to spread the cut potatoes out about five or six inches deep and turn over daily until dry, when they may be sacked or stored in bulk until time to plant. Cutting immediately before planting is the best method when it is practical and possible.

Effect on Yield and Grade of Size of Seed Pieces.—The following results of an experiment on the sizes of seed pieces are quoted from Circular 106 of the Missouri Station.

"*Experiments on size of seed piece* and whole vs. cut seed pieces have been conducted with the Early Ohio variety. The smallest size of seed piece was about ⅔ ounce and the largest size nearly 2 ounces. As was to be expected the total yield increased with the size of the seed in every case. The increase is greatest from the ⅔ ounce to the 1 ounce class, becoming smaller with further increase in size of seed piece. The larger seed pieces produced a higher percentage of culls. The increase in yield of No. 1 potatoes from the ⅔ ounce to the 1 ounce seed pieces is considerable, but the gain in the No. 1 grade beyond this point is slight. This is important since the yield of the No. 1 grade practically determines the value of the crop.

"*Concerning cut vs. whole seed* pieces, we have here an opportunity to make a direct comparison between seed pieces of the two types which are of the same weight. In total yield, cut seed produced less than whole seed in nearly every case with the spring home-grown class of seed; but in the northern-grown seed the reverse is true. In yield of No. 1 grade, the whole seed gave a less favorable showing; for in most cases, the cut seed produced the greater yield of No. 1 grade in both classes."

Under average conditions, a seed piece about the size of a hulled walnut will give good results. In very dry or irrigated soils the seed pieces should be larger than in soils well supplied with moisture. The young potato plants feed upon the plant food stored in the seed pieces, and the cuts should be sufficiently large to give the plants a quick, thrifty start. Planting potato eyes or peelings is a poor practice.

Job 8. Planting and Fertilizing

Conditions Usually Found.—(1) Commercial fertilizers are applied at or about the time of planting in the commercial areas. (2) The methods and time of planting vary greatly with the seasons and purposes for which the potatoes are grown.

Aims.—(1) Students should know the best time to plant in order to have the potatoes ready for market when prices are highest. (2) They should know the time and amount of fertilizers to apply.

Problems for Study and Discussion.—(1) When are potatoes usually planted in your community?

2. At what depth should the seed be placed in the soil? Compare merits of deep and shallow planting.
3. Discuss methods of ridging for low and upland soil.
4. What are the advantages of level planting?
5. What effects have the interval of planting in rows and width between rows on yield and size of potatoes?
6. How does distance between rows affect weed control and tillage?
7. How does rate of planting affect capital invested in the crop? Would heavier planting pay?

8. At what distances will you plant your crop? Why?
9. Calculate the savings in labor by using a potato planter for the larger fields of your community.
10. What types of machine do farmers of your section use for planting potatoes?
11. How can you convert a potato planter into a fertilizer distributer?
12. How and when do farmers of your section apply fertilizer for potatoes?
13. How many pounds per acre would you recommend? What factors would cause this to vary?
14. Make out a schedule for planting and fertilizing your crop.

FIG. 172.—The two-man potato planter in operation. The extra man aids in securing a very uniform planting of pieces. (Fred. H. Bateman Co.)

15. What are the benefits of ridging rows before planting?

Activities.—(1) Operate planters, if possible, and change their adjustments. (2) Compare types of planters. (3) Try to devise a home-made machine planter to be operated by two boys. (4) Plant parts of a field at two different rates of seeding to compare results.

Planting by Hand.—If hand methods of planting are used, the rows are usually marked out with a plow and the potatoes dropped at suitable distances in each furrow. Distances between rows are usually three feet or a little more. Two-eye pieces are dropped at intervals of from one to two feet. Such planting would require from 12 to 18 bushels of seed per acre. A plow is used in covering. Ridges formed are harrowed later, to reduce the height. The depth of covering in light soils is about four or five inches.

In heavy soils the depth is less. Covering may be done with harrows or with hand methods.

Machine Planting.—These are of two main types: (Figs. 172 and 173); (1) Those requiring two persons, one to drive the team and another to equalize the distribution of seed in a revolving disk which drops the pieces; (2) those which require only one man, the dropping being done by forks

FIG. 173.—A one-man automatic potato planter in operation. (Fred H. Bateman Co.)

attached to the rim of a revolving vertical disk. The two-man machine is more accurate and gives a more even set in the field, but the time of an extra man is involved. Machine planters open their own furrows, drop the seed, spread the fertilizer, and cover the row in one operation.

Fertilizing.—If commercial fertilizer is used, it should contain considerable potash to supplement the other forms of manure. This is applied at planting time, either in a special fertilizer drill attached to the planter or by hand in the furrow—not against the tubers. A fertilizer box placed

on the planter ahead of the dropper allows the spreading of the fertilizer while planting.

Level vs. Ridge Planting.—Ridging was described in the preceding job. This method is better suited to the early crop than to the fall crop because of the differences in soil moisture. Many growers prefer level planting because moisture can be conserved and because cross-harrowing may be practised before and after sprouting of the potatoes.

Job 9. Cultivating

Conditions Usually Found.—(1) Many large growers cross-harrow their fields before the potatoes come up. (2) Potatoes are usually well cultivated.

Aims.—The advantages of cross-harrowing or weeding before and after potatoes come up and the best methods of cultivation to follow in growing potatoes should be understood.

Problems for Study and Discussion.—(1) How do the most successful growers of your section cultivate potatoes?

2. What effect has cultivation on the conservation of soil moisture?
3. List other benefits that result from cultivation.
4. Why should light and heavy soils be cultivated differently? Discuss.
5. Why should potatoes be cultivated often?
6. When should much soil be moved in cultivation?
7. On what types of soil is it necessary to "hill" or ridge the rows? Why?
8. Make a list of the necessary implements for cultivating your crop according to best methods. What would be the cost of this equipment?
9. Describe a good method of cultivating potatoes the last time.
10. At what stage in the development of the potato plant should the last cultivation be made?

Activities.—Examine and compare different types of cultivators, harrows, and weeders.

Cross-Harrowing.—Much labor can be saved by using a spike-tooth harrow or a wide weeder over the field before and after the sprouts emerge from the soil. Several harrowings may be made before the cultivator needs to be used. This controls weeds, saves moisture, prevents crusting and allows birds to pick up insects.

Row Cultivation.—The first cultivation between the rows should be deep and should stir the soil thoroughly. This will tend to prevent packing of the soil about the roots and crusting of the surface. Cultivate again after each heavy rain and often enough to keep a good mulch and prevent growth of weeds. The roots of potatoes are not so shallow as are those of corn and sorghum. Deeper cultivation is allowable and beneficial. The cultivator should be run more shallow as the season advances. The last cultivation is usually given about the time of early blossoming of the crop. With many varieties the vines will then cover the surface fairly well (Fig. 174).

Hilling up the rows during cultivation period or at the last of it is sometimes done, for two purposes; to prevent the tubers from being

sunburned, and to cover grasses and weeds in the row. In the most extensive commercial growing regions, a slight ridging of the rows at last cultivation is commonly practised.

Job 10. Controlling Insects and Diseases

Conditions Usually Found.—(1) Heavy losses from enemies of the potato crop occur each year. (2) Many farmers fail to appreciate fully the value of controlling insects and diseases of potatoes. (3) The larger producers usually control diseases and insects as well as it is practicable to do so.

Aims.—Students should learn the best methods of controlling the most common diseases and insects which injure potatoes in their community.

Problems for Study and Discussion.—(1) Ask growers to tell what insects and diseases are most injurious locally.

2. List the names of other insects and diseases not yet found locally.
3. List two insects and two diseases doing the most damage.

Fig. 174.—This vocational boy is proud of his potato project. Good tillage was his greatest cause of success. Cultivation is just over. (Emory Smith, Nor. Car.)

4. Describe the best method of controlling the following insects: a. Potato beetles. b. Potato aphids. c. Four-lined leaf bugs. d. Cut worms. e. Stalk borers. f. Stalk weevils.
5. Describe the best method of controlling the following diseases: a. Early and late blight. b. Rhizoctonia. c. Soft rot. d. Common scab. e. Black-leg.
6. Make a spray calendar and list of solutions for controlling the above insects and diseases.
7. What causes late and early blight? How do these diseases spread?
8. What is Rhizoctonia?
9. What type of sprayer would you use for large fields? Small fields?
10. What effect has a good spraying campaign on yield per acre?
11. What is the difference in the mouth parts between a sucking and a biting insect?
12. What is a stomach poison for insects? Give example.
13. Name a contact insecticide suitable for aphids.
14. What compound spray formula would you use to control the following three enemies at once? Early blight, potato beetles, potato aphid.
15. How is Bordeaux mixture made?
16. Compare dusting with spraying for leaf-eating insects.

Activities.—Make a collection of the insects and diseases that injure potatoes of your region. Practice making Bordeaux mixture. Practice spraying and dusting plants.

Controlling Insects and Diseases.—Spraying for the control and prevention of diseases and insects is practised by practically all potato growers of the country. It is impossible to estimate very accurately the losses caused by the various insects and diseases which affect the potato. A study of the various experimental results from spraying convinces us, however, that the losses are enormous and spraying profitable.

Experiments with Late Potatoes.—The following results from trials in spraying potatoes in North Carolina show conclusively the value of spraying:

"Our experiments with the late crop in the western part of the state have shown that the best material to use is the home-made poisoned Bordeaux mixture; this material has yielded the greatest returns during each of the six years it has been used. The poisoned Bordeaux mixture not only successfully controls flea-beetles and potato beetles, but prevents early and late blight. It is these insects and diseases which decrease the yields of late potatoes when they are not sprayed.

COMPARISON OF YIELDS AND NET GAINS IN VALUE FOR LATE POTATOES SPRAYED AND UNSPRAYED, OVER SIX-YEAR PERIOD

(N. C. Station Extension Circ. 103)

SEASONS	TREATMENT	YIELD IN BUSHELS PER ACRE	GAIN IN BUSHELS PER ACRE OF SPRAYED OVER UNSPRAYED	NET VALUE PER ACRE OF SPRAYED OVER UNSPRAYED *
1	Sprayed 5 times	187	49	$29.58
	Unsprayed	138		
2	Sprayed 5 times	52	27	25.26
	Unsprayed	25		
3	Sprayed 3 times	114	32	18.92
	Unsprayed	82		
4	Sprayed 4 times	218	104	111.71
	Unsprayed	114		
5	Sprayed 4 times	136	46	50.40
	Unsprayed	90		
6	Sprayed 4 times	161	53	76.21
	Unsprayed	108		
Average, six years			52	$52.01

* Cost of spraying has been deducted and potatoes valued at current prices at time of digging.

"The average increase for the six years was 52 bushels per acre, with a net gain (after the cost of spraying and materials were deducted) of $52.01 per acre.

Experiments with Early Potatoes.—"Spraying experiments with the early crop in the eastern part of the state have not covered as long a period as those with the late crop in the western, but the results of four different experiments over a two-year period indicate that early potatoes make the greatest yield when sprayed with the same home-made poisoned Bordeaux mixture. In these experiments as many as twelve plots have been used. Each plot was treated either with a commercial Bordeaux compound, home-made Bordeaux with and without poison (Fig. 175), or dusted with dry poisons such as lead arsenate and calcium arsenate.

FIG. 175.—A good type of traction sprayer for commercial growers. Note the two nozzles between each two rows furnishing an upward spray, which insures a thorough coating of the lower surfaces of the leaves. (Fred H. Bateman Co.)

"We find by our observations that the chief destructive factor of early potatoes in the east is the potato beetle (Fig. 176), although flea-beetles, plant lice, and early blight are frequently present in destructive amount. Potato beetles and flea-beetles are readily controlled by the use of a poison alone. However, the combination of Bordeaux mixture and poison would seem to be the safest, as the Bordeaux will then be present to check early blight, should it develop. Moreover, the cost of the spray will be but little more when the poison is combined with the Bordeaux mixture, the cost being readily justified by the general good this mixture does to the vines.

"If an average of the four experiments be made, (see accompanying table) we have an increase, by spraying, of 26.1 barrels per acre, which were valued

at $161.92. The losses incurred on the unsprayed potatoes were almost entirely the result of defoliation by potato beetles which in some instances completely reduced the vines to stems, causing them to die early in the season. Early blight developed very late in the season, but the potatoes were dug for early shipment before the blight had inflicted serious injury.

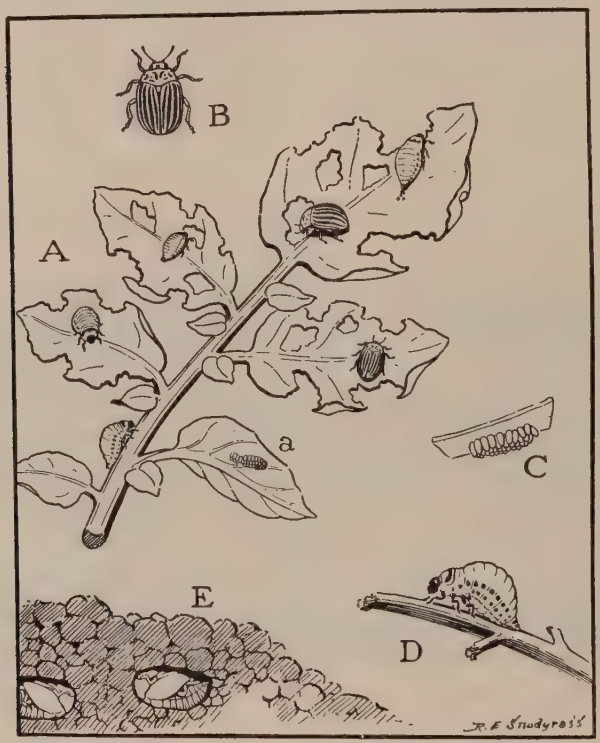

FIG. 176.—The Colorado potato beetle. A, section of plant showing the potato beetle at work. B, the beetle, C and a, clusters of eggs clinging to under surface of leaf. D, mature larva. E, pupa. (U. S. Bu. of Entomology.)

"It is true that these losses could have been reduced greatly by using a poison alone, but the Bordeaux mixture in combination with the poison produced results that justified its use. Had early blight developed earlier in the season as it sometimes does, the unsprayed potatoes would have yielded even less."

The diseases and insects prevalent in the South have been found to be identical with those of the Northern sections where seed po-

COMPARISON OF YIELDS AND NET GAIN IN VALUE OF EARLY POTATOES SPRAYED WITH THE POISONED BORDEAUX MIXTURE AND UNSPRAYED. FOUR EXPERIMENTS—COASTAL PLAIN SECTION

(N. C. Ext. Circ. 103)

PLACE	TREATMENT	YIELD IN BARRELS PER ACRE *	GAIN IN BARRELS PER ACRE OF SPRAYED OVER UNSPRAYED	NET VALUE PER ACRE OF SPRAYED OVER UNSPRAYED †
New Bern	Sprayed 3 times.....	35.0	11.5	$ 41.58
	Unsprayed.....	23.5		
New Bern	Sprayed 3 times.....	82.0	37.0	185.00
	Unsprayed.....	45.0		
Mount Olive	Sprayed 3 times.....	60.0	17.7	88.50
	Unsprayed.....	42.3		
Wilmington	Sprayed 4 times.....	58.3	38.3	332.62
	Unsprayed.....	20.0		
Average, four experiments.....			26.1	$161.92

* Two and three-fourths bushels to the barrel (at time of digging).
† Cost of spraying has been deducted and potatoes valued at current prices.

tatoes are grown. Similar methods of control are also employed. Following are a few of the more important diseases and insects:

Diseases	Insects
1. Early and late blight	1. Potato beetles
2. Rhizoctonia	2. Four-lined leaf bugs
3. Soft rots	3. Potato aphids
4. Common scab	4. Cut worms
5. Black-leg	5. Stalk borers
6. Black scurf	6. Stalk weevils
7. Mosaic	7. Leaf-hoppers (Figs. 177–178)
	8. Three-lined beetle (Fig. 179)

A study of these and other diseases may be made by using the North Carolina Extension Circular 103 "Spraying Irish Potatoes," Florida Station Bulletin 169 "Potato Diseases and Insects," and Stuart's "The Potato." The following spraying program for late and early crops is recommended in circular 103.

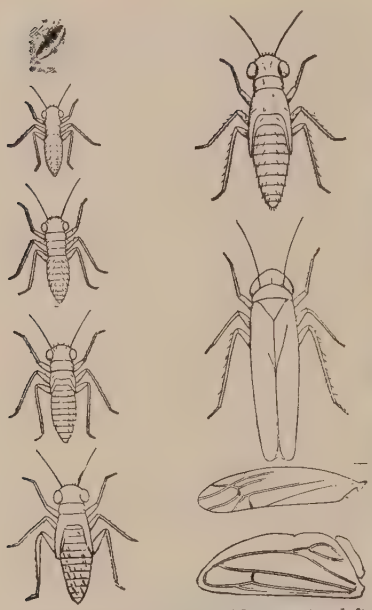

FIG. 177.—The potato leaf-hopper, top left egg, all others show stages of life cycle. (U. S. Bureau of Entomology.)

FIG. 178.—Hopper burn—result of the work of leaf-hoppers. (U. S. Bu. of Entomology.)

FIG. 179.—The three-lined potato beetle (Lema Trilineata) at work. (U. S. Bu. of Entomology.)

"Spraying Late Potatoes.— Spray four or five times with the home-made poisoned Bordeaux mixture containing 3 pounds of bluestone, 4 pounds of stone lime, 1½ to 2 pounds of dry arsenate of lead to each 50 gallons of water. This spray will cost about $8 per acre for four treatments, and will increase the yield over potatoes not sprayed by about 52 bushels per acre.

"Spraying Early Potatoes.— Spray three or four times with the home-made poisoned Bordeaux mixture, using formula of preceding paragraph, but add more arsenate of lead if the beetles are numerous and destructive. Omit the Bordeaux mixture and use only the poison, if it is desired, early in the season; but

be sure to use it during late May and June. It is safest and cheapest in the long run, however, to use the poisoned Bordeaux mixture from the beginning. Three applications of the poisoned Bordeaux mixture will increase the yield from 12 to 40 barrels (33 to 110 bushels) per acre.

"**Dusting.**—If not equipped for spraying, then dust, using dry lead arsenate and lime (1 to 6 or 1 to 8) applying by shaking in a sack over the plants while the dew is on them. The pure poison may also be sparingly applied with a dust gun.

"Dusting will produce good results when the potato beetle alone is the cause of injury, but it is not a method of insuring the plants against blight, which may develop later in the season. If you are equipped to spray, use the home-made poisoned Bordeaux mixture. It will give the best returns and is the most economical in the long run."

Job 11. Harvesting and Grading

Conditions Usually Found.—(1) Potatoes grown for home use are usually hand dug and stored without grading. (2) Potato-digging machinery is used on commercial fields. (3) Commercial growers who ship potatoes to distant markets grade their potatoes according to U. S. standards.

Aims.—(1) Growers should know the standard grades of potatoes. (2) They should learn the best methods of harvesting and grading.

Problems for Study and Discussion.—(1) How are potatoes usually harvested in your community?

2. At what time of day should potatoes be plowed out of the ground?
3. What effect has sun scald on the grade of potatoes?
4. How may growers by careful harvesting methods avoid sun scald?
5. Why would you not dig potatoes when the soil is wet? What soils will allow most moisture at digging time?
6. What types of containers do growers usually use for shipping potatoes? Discuss barrels vs. bags for the early crop.
7. How do growers of your community transport potatoes from the field to the terminal?
8. What are the advantages to both growers and buyers of official inspection before shipping?
9. What does it usually cost to get a car inspected?
10. Where is grading usually done and how?
11. Discuss the economy of grading in the field when picking up early potatoes.

Activities.—(1) Adjust and operate harvesting implements of one or more types (2) Keep time on different harvesting methods and compare them.

The steps at harvest time may be enumerated as follows: (1) Securing barrels and containers. (2) Judging maturity and probable yield of crop (Fig. 167). (3) Distributing the barrels in field (Fig. 180). (4) Digging the tubers (Fig. 181). (5) Picking and grading the tubers

(Fig. 182). (6) Hauling from field to shipping point (Figs. 183–184). (7) Inspecting (Fig. 185). (8) Grading or regrading if not well done by pickers (Fig. 186). (9) Loading in cars.

FIG. 180.—Large frames are used to haul empty potato barrels to the field. (Nor. Car. Division of Markets.)

FIG. 181.—A tractor potato digger in operation in one of the largest commercial potato sections of the country. Tubers are left almost free of dirt and ready for picking up into barrels. (Fred. H. Bateman Co.)

Harvesting.—Horse drawn diggers which throw the potatoes up are of two types: (1) The plow type may or may not have potato prongs to

help separate the soil from the tubers. These are very inexpensive and are of great help in harvesting. On small commercial fields they are very

FIG. 182.—A typical scene in the South, picking and grading potatoes. (North Carolina Division of Markets.)

economical. (2) Machine diggers may be drawn either by horses or tractors. They elevate the potatoes over the frame of the machine and leave them

FIG. 183.—A method of protecting potatoes on top of the barrels from sun scald by shading with potato vines. Part of a project yield by a vocational boy of North Carolina. (Emory Smith.)

lying on top of the soil, usually on one side of the row. The labor in picking up the potatoes after these machines is less than in any other type.

Hand-Picking.—Men, women and children are often employed in picking up potatoes in baskets or crates. If grading is done in the field the pickers must be trained for such work.

FIG. 184.—This vocational boy had to have help to load his project potatoes on the two-wheeled cart, a common method of transporting potatoes to the shipping point. (J. H. Roller, State Inspector, N. C.)

Grading.—The average farmer is not familiar with the standard grades of potatoes and too often puts all grades together when digging.

FIG. 185.—Pouring potatoes back into the standard barrel container after opening for inspection. Each car is inspected and the grade or grades recorded on an official record sheet. (J. H. Roller, Div. of Markets, N. C.)

It is not so important for the grower of small lots who markets his potatoes on a local market as a truck crop to grade his potatoes as it is the

large commercial grower, who consigns his potatoes to the commission house at a price subject to the grade. The commercial growers use the U. S. standard grades when marketing their crop. The potatoes are either graded by hand picking when dug (Fig. 182) or graded by special machines for that purpose (Fig. 186) and put in standard barrels or other containers and placed at the shipping point for inspection. The inspection is made

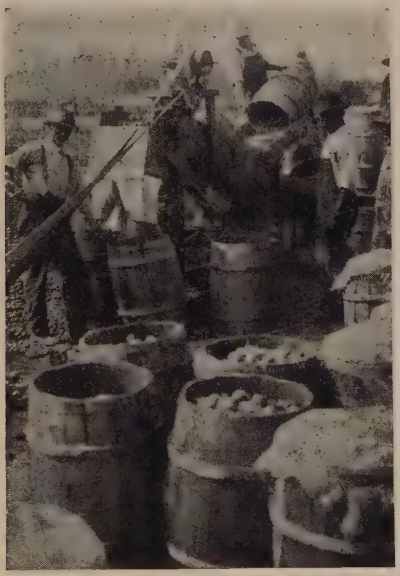

FIG. 186.—A potato grading machine in operation in the commercial section of Eastern North Carolina. (N. C. Division of Markets.)

FIG. 187.—Potatoes graded and packed in the car ready for shipment. This is a partial view of a car of U. S. No. One's "Pamlico Cobblers" packed in standard ventilated barrels and shipped from eastern North Carolina in June, 1927. (N. C. Div. of Markets. J. H. Roller, Inspector.)

by the government and state department of agriculture coöperating at a usual price of about $4.00 per car.

The three official standard grades as classified by the U. S. Department of Agriculture June 30, 1925, are given.

"**U. S. No. 1** shall consist of potatoes of similar varietal characteristics which are not badly misshapen, which are free from freezing injury and soft rot, and from damage caused by dirt or other foreign matter, sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry rot disease, insects, or mechanical or other means.

"The diameter of potatoes of round varieties shall be not less than 1⅞ inches and of potatoes of long varieties 1¾ inches, but lots of potatoes which

are not less than 1½ inches in diameter and which meet the remaining requirements of this grade may be designated 'U. S. No. 1, 1½ inches minimum.'

"In order to allow for *variations* incident to proper grading and handling, not more than 5 per cent, by weight, of any lot may be below the prescribed size, and in addition, not more than 6 per cent, by weight, may be below the remaining requirements of this grade, but not to exceed one-sixth of this tolerance or 1 per cent shall be allowed for potatoes affected by soft rot.*

"U. S. No. 2 shall consist of potatoes of similar varietal characteristics which are free from freezing injury and soft rot and from serious damage caused by sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry rot, disease, insects, or mechanical or other means.

"The diameter of potatoes of this grade shall be not less than 1½ inches.

"In order to allow for *variations* incident to proper grading and handling, not more than 5 per cent, by weight, of any lot may be below the prescribed size, and, in addition, not more than 6 per cent, by weight, may be below the remaining requirements of this grade, but not to exceed one-sixth of this tolerance or 1 per cent shall be allowed for potatoes affected by soft rot.*

"U. S. Fancy shall consist of potatoes of one variety which are mature, bright, well shaped, free from freezing injury, soft rot, dirt or other foreign matter, sunburn, second growth, growth cracks, hollow heart, cuts, scab, blight, dry rot, disease, insect, or mechanical injury, and other defects.

"The size shall be stated in terms of minimum diameter or minimum weight or of range in diameter or weight following the grade name, but in no case shall the diameter be less than 2 inches.†

"In order to allow for *variations* incident to proper grading and handling, not more than 5 per cent, by weight, of any lot may be below the remaining requirements of this grade, but not to exceed one sixth of this tolerance or 1 per cent shall be allowed for potatoes affected by soft rot."*

Job 12. Storing Potatoes

Conditions Usually Found.—(1) Growers of large potato crops in the South usually sell their potato crops to dealers at or about harvesting time and consequently do not store their potato crops. (2) Farmers usually store potatoes for home use by pitting or in cellars.

Aims.—(1) Students should know under what conditions potatoes can be stored. (2) They should know the principles and methods of potato storage best suited to their purposes.

Problems for Study and Discussion.—(1) What are the objects of storage?
2. How are potatoes stored by growers of your section?
3. What is meant by "pitting"?
4. Why ventilate a potato pit? How is this best done?
5. What size and shape of pit would you use?
6. Will potatoes keep in moist pits? Why not?
7. List several causes why potatoes rot in the pit?

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* Soft rot or other deterioration developing in transit on potatoes otherwise up to grade shall be considered as affecting the condition and not the grade.

† Such statements as the following will be considered as meeting the requirements: "U. S. Fancy, 2 to 3¼ inches"; "U. S. Fancy, 10 ounces to 16 ounces"; "U. S. Fancy, 2 inches minimum"; "U. S. Fancy to 10 ounces minimum."

8. Tell in detail how you would make a potato pit to incur the smallest losses.
9. Under what conditions is a cellar or basement suitable for storing potatoes for home supply?
10. What special attention do you have to give a potato pit just after storage? Why?
11. What are the advantages of drying before storing in cellars?

Activities.—(1) Draw plans for a storage house. (2) Calculate the cost of building such a house. (3) Estimate the cost of a storage cellar. (4) Find the capacity of each.

Storing Early Potatoes.—The North Carolina Station has shown that it sometimes pays to store the early crop in sweet-potato houses if they are available. These potatoes will keep with little loss until September, when the price is usually a little higher than at early harvest time.

Storing Late Potatoes.—The late or fall crop will bring a better price if held until the glut of harvest time is over. Therefore some method of storing potatoes is planned by large growers. Usually storage houses are constructed by individuals rather than by associations. Potatoes should be kept at a temperature a little above freezing. Places should be rather well ventilated but not too dry. The tubers stored should be sound and free from injury at storage time. If they are roughly handled great loss from rots may follow.

Pitting Potatoes is a crude and common method, involving little or no expense for equipment. Inexpensive cellars, wholly or partially underground, are cheap forms of buildings for storage. Such cellars or dug-outs may be in banks or hillsides for convenience in handling the product.

Storage Houses.—Expensive structures in the form of good storage houses are found in those sections where large fall crops are produced. These are more common in the North than in the South. The walls are well insulated and the tubers are protected from freezing, usually without stoves in southern regions.

Benefits of Storage.—The chief reasons for holding the main crop or fall crop of potatoes may be enumerated as follows: (1) The crop is saved for home use. (2) The market crop will probably bring enough money to more than pay the cost of storage.

Shrinkage in Storage.—Any reduction in weight of the crop stored is called shrinkage. This is due to evaporation of moisture if the storage place is too dry; rots, which destroy a portion of the crop; freezing, which prevents tubers from selling and makes them unfit for human use.

Job 13. Marketing the Crop

Conditions Usually Found.—(1) Most growers of large crops in the South market their crops at digging time. (2) Farmers who grow potatoes for home

use usually sell their surplus on local markets. (3) Potatoes of standard grades marketed in standard containers bring highest prices on the market.

Aims.—Students should know the best methods of handling, loading, shipping, finding markets, dealing with agents, and coöperating with other growers.

Problems for Study and Discussion.—(1) How do growers of your section market their potatoes?

2. What are the advantages of using containers of uniform size?
3. Name the types of containers used in your section.
4. What fraction of the local potato crop is usually sold to buyers at f. o. b. prices? How much is consigned to commission houses?
5. Which method of selling is best? Why?
6. How does inspection by experts at the point of shipping protect the grower?
7. When is the best time to market the early crop? The fall or late crop?
8. Discuss methods of placing containers in cars for shipping.

Activities.—(1) Make a study and graph the market prices of potatoes for the past five years. Explain the relation between production and prices. Is it your opinion from this study that the next crop will bring a low or high price? Why? (2) Aid in loading cars of potatoes for shipment.

Selling the Early Crop.—This is the most important part of the marketing in southern states. Very few late potatoes reach large markets from southern growers.

The early crops are usually marketed directly from the field, as a loss of a single day may result in a lower price. Plans must be made in advance for handling the crop rapidly. Containers, trucks, wagons, and cars must be engaged in advance. Plenty of pickers must be diligently at work. Grading is done while packing.

Coöperative Selling.—Associations of growers save the members much expense at marketing time. Cars are furnished the members on the nearest tracks ready to receive the crop as it is harvested. These cars are sent to the best markets as rapidly as loaded. Connections are made with several of the best markets so that shipments are directed to points where the demand is greatest. Glutted markets are thus usually avoided. Coöperative associations can handle such matters better than individuals, because of the knowledge and experience involved.

COÖPERATIVE MARKETING

Brings better price
Maintains high standards
Opens better markets
Stimulates production
Interests more growers
Lowers shipping costs
Reduces overhead expense
Fosters community spirit
Functions for middlemen
Uses government inspection

Selling to Commercial Dealers.—Individuals often sell directly to dealers or to consumers of large quantities of potatoes. Commission men often handle large quantities of southern early potatoes in the large

FIG. 188.—A trainload of cars being loaded with early potatoes for shipment to northern markets. (No. Car. Division of Markets.)

FIG. 189.—Smaller boats lined up at Elizabeth City, N. C. for loading. (No. Car. Div. of Markets.)

FIG. 190.—One of the large steamers loaded with potatoes at Elizabeth City, N. C., and ready to shove off for northern markets. (No. Car. Div. of Markets.)

markets. Consignments are made by growers or others to commission men who charge a fixed commission for the selling.

Packing in cars has recently been a matter of much careful study. Each kind of container, as barrels or baskets, should be packed so as to result in the least possible damage to the product (Figs. 187 and 188). Shipment by boat is common along the seaboard. This is done with less injury to the "green" tubers (Figs. 189 and 190).

Job 14. Keeping Records

Conditions Usually Found.—The average farmer or grower does not keep accurate cost account records on his potato crop.

Aims.—(1) Students should know the items of cost in producing potatoes. (2) They should keep accurate records of all costs and receipts. (See corn enterprise.)

Things to Make at Home.—Crates for use in picking up potatoes in the field; bag holder for sacking potatoes; fertilizer spreader; hopper boxes for use on corn planter in planting potatoes.

SWEET POTATO ENTERPRISE

By Wm. H. Garrison, B.S., M.A.

Assistant State Supervisor Agricultural Education, South Carolina

Analysis into Jobs.—The following are the main jobs for the growing and marketing of sweet potatoes. References are made to U. S. Farmers' Bulletin 999 and others. See also *The Sweet Potato* by Hand and Cockerham.

1. Determining possibilities with sweet potatoes.
2. Financing the enterprise.
3. Deciding soil, acreage, and site.
4. Providing organic matter, and winter care of soil.
5. Selecting the variety to plant.
6. Securing seed and growing.
7. Selecting and applying fertilizers and manures.
8. Preparing the soil for planting.
9. Transplanting plants.
10. Cultivating the crop.
11. Controlling enemies. 1059.
12. Harvesting, grading, and selecting seed.
13. Curing and storing sweet potatoes. 847, 970, 1267, 1442; U. S. D. A. Bul. 1063.
14. Marketing sweet potatoes.
15. Summarizing cost records. 511, 572, 782, 1182.

Job 1. Determining Possibilities with Sweet Potatoes

Conditions Usually Found.—(1) The sweet potato is grown for home use practically all over the South. (2) It is also used rather extensively as a money crop in the warmer section, ranking about third among the commercial truck crops. (3) Its value and importance are rapidly increasing. (4) There is an increasing demand for sweet potatoes on the northern market. (5) It can be grown for home use under a wide range of conditions.

Aims.—Growers should decide whether or not they can raise sweet potatoes conveniently and profitably as a commercial crop on their farms. They should consider raising sweet potatoes for home use.

Problems for Study and Discussion.—(1) Make a survey and determine the acreage planted in sweet potatoes in your community.

2. To what extent are the areas increasing or decreasing?
3. Determine approximately the cost per acre and the labor returns per hour in growing sweet potatoes.
4. What disposition is made of the crop produced in your community?
5. Make a study of your soil and determine the type and condition.
6. Make a study of marketing possibilities.
7. Study labor conditions on your farm and determine whether or not the sweet potato enterprise will fit well into the farm program.
8. Determine the initial investment, length of investment, and the total cash outlay.

9. Determine the financial, climatic, insect, and disease risks.
Activities.—Make a table of local yields, prices received and opinions regarding the growing of the crop.

The soil on the home farm is probably the first factor that should be considered. While it is true that the sweet potato adapts itself to a great variety of soils, the best results are obtained from well drained, sandy loams or light clay-loam soils with clay subsoils. A sandy-loam soil with a moderate amount of organic matter is preferred. For home use, sweet potatoes may be grown in a clay soil if it is rather loose and rich. The commercial crop, however, should be confined to the light or sandy soils.

Climatic requirements should also be considered in the beginning. From a commercial standpoint there must be a growing period of at least four months, without frost, with warm nights and plenty of sunshine during the day, and a moderate rainfall during the growing season. Irrigation is depended upon in some of the western states, including parts of Texas. The above mentioned climatic conditions are fulfilled in practically all the central and eastern southern states.

Marketing, Curing, and Storing Facilities.—A good market usually exists for sweet potatoes when the proper variety and quality is grown. It is well to get the advice of a marketing specialist on this point. If the crop is to be shipped to northern markets, storage and curing houses of known success are necessary. If, however, the crop is to be sold on the nearby local market and used at home, such houses are not necessary, but afford safer storage and better quality. Nearness to market is a factor that should be considered.

The probable profit or labor income should be determined as accurately as possible. This factor will be determined by the marketable yield, cost of production, and price. A yield of one hundred bushels per acre can usually be expected on the average southern soil; however, two hundred bushels per acre is not uncommon, 60 to 80 per cent of which may be marketable. These factors should be considered on the basis of local experiences. The agricultural class should make a survey of the community, determining the average yield, cost of production, and prices received. Average results for a period of years should be obtained. Experiences of the most successful growers in the community are very helpful in determining the possibilities of this enterprise as a money crop. The labor income from sweet potatoes should be compared with that from the other money crops.

The farm labor program must be considered in deciding whether or not to grow sweet potatoes as a money crop. Students should first make an estimate, based on local experiences, of the amount of labor required to grow a certain acreage. They should also determine the yearly

distribution of this required labor. The available labor on the farm, including that of the grower, should be worked out very accurately. The results thus obtained will enable the student to determine the acreage in sweet potatoes that can be taken care of by the farm labor without interfering with the general farm program. Farm management surveys and the agricultural statistician's reports should be used in making the above studies.

Job 2. Financing the Enterprise

Conditions Usually Found.—The student or other growers may or may not have enough money on hand to finance the crop. It very often happens that money has to be borrowed or the crop financed by someone else.

Aims.—Growers who do not have the money should decide the best method of financing.

Problems for Study and Discussion.—(1) How do farmers finance their crops?
2. How many of these borrow money for this purpose?
3. How many of them buy necessary articles "on time"?
4. From whom are such purchases made?
5. Talk with bankers and business men as to methods of financing such crops.

Methods of Financing.—The methods most commonly used are listed. (a) Borrowing money from the bank. (b) Borrowing the money from parents or other interested individuals. (c) Borrowing the money from local business men. (d) Buying "on time." (e) Having father furnish everything. (f) Using money made on previous projects.

If the student has enough money of his own to finance the enterprise, there is no problem. The following discussion is for the young farmer who does not have the necessary cash, and who has to make arrangements for borrowing.

Securing Funds.—As a basis for securing funds the following points should be estimated fairly accurately: (1) The acreage to be planted. (2) The amount of fertilizer to be used. (3) The amount of seed or plants necessary. (4) Rent of the land. (5) Approximate amount of labor that will have to be hired. (6) The yield expected. (7) Disposition to be made of the crop. From these data and from market prices a fairly good estimate can be made of the possible profit and of the amount of money that will have to be borrowed.

The student should then go before the bank or party having money to lend and present this preliminary cost account. The interest rate should be obtained from several different sources, with the idea of getting the money as cheaply as possible.

Very often a bank will let vocational agricultural boys have money at a slight reduction below regular rates. This is done, first, to encourage the boys, and second, because the project will be thoroughly supervised by a competent teacher, which increases the chances for success.

As a rule it is much more economical to borrow the money on which to operate than it is to buy "on time," but it should be the ambition of each individual to get in position where he can do his own financing.

Job 3. Deciding Acreage, Soil, and Site

Conditions Usually Found.—Commercial growers consider these matters carefully. Very little attention is given to the type of soil where sweet potatoes are planted on a small scale for home use. The location of the field or patch is determined by convenience and crop rotation.

Aims.—Each student should select the best place for sweet potatoes that is available on his farm, and decide what acreage to plant.

Problems for Study and Discussion.—(1) What acreage is usually planted to sweet potatoes on your farm each year?

2. What is the average for your county? (Use state statistician's report.)
3. Make a study of the types of soil used for sweet potatoes in your community.
4. What factors are considered in locating the field or fields for sweet potatoes?
5. What effect does the rotation system have on the location of your field?

Activities.—Tabulate the names of several growers showing acreage, soil, and whether each is increasing or decreasing his area.

The acreage to be devoted to the sweet-potato project will be determined largely by the purpose for which the crop is grown. Other determining factors are: storage and marketing facilities, available labor, adaptation of soil and climate, and the possible profit per acre.

If sweet potatoes are to be grown for home use only, a small patch will be sufficient. This is determined by the size of the family. Growing sweet potatoes for home use is not a very satisfactory project, as the pupil seldom gets any financial benefit from his project.

Size of Project.—If the crop can be marketed locally or shipped to distant markets, a large project may be carried out. For the average high school boy, from two to three or more acres should be planted. This will vary, of course, in different communities and with different boys. The acreage grown by the best farmers in the community should be taken into consideration.

Choosing Good Soil.—As has been stated before, sweet potatoes should be grown on well drained sandy-loam or light clay-loam soil with a clay subsoil. It is not necessary to select a soil in a high state of cultivation, as sweet potatoes do well on soil of fair fertility. Black soil or soil infested with root-rot should be avoided. It is not desirable to use soil on which potatoes were grown the previous year. Crop rotation is very essential in growing sweet potatoes. If potatoes are grown on the same land several years in succession, there may be trouble from disease. A very deep soil should be avoided, as ill-shaped roots may result. It is best not to plant potatoes on land in which the hardpan is more than twelve inches from the surface. If the soil is too deep the potatoes tend to grow long and, therefore, do not conform to the desirable type for market.

A large amount of organic matter is not always necessary; a medium supply however, should be present in the soil. Too much in the form of tough sod may be injurious. Potatoes do well after clover or some crop that rots quickly. With the above points in view, the student should examine the farm thoroughly and locate the field best adapted to this enterprise (Fig. 191).

Locating.—There is not much choice as to the location of the field with reference to the farm. The project site should, however, be as conveniently located as possible. All things being equal, it would be best to have it in a field to itself. It would also be well to have the patch as near the house as possible and in a location easily accessible to the team.

FIG. 191.—This student has made a good selection of soil and site for his sweet potato project. The result is a successful crop. (P. L. Trent.)

Job 4. Providing Organic Matter; and Winter Care of Soil

Conditions Usually Found.—On a majority of the farms the supply of organic matter is deficient and the soil left bare during the winter.

Aims.—Decide the best way of adding organic matter and the best winter cover crop.

Problems for Study and Discussion.—(1) Visit a number of the farmers in your community and find what cover crops are used during the winter prior to growing sweet potatoes.

2. Compare crimson clover, vetch, and rye for this purpose.
3. Determine what disposition is made of this cover crop.
4. What local farmers use barnyard manure for sweet potatoes? (Fig. 192.)
5. What other methods are used by the farmers of your community in supplying the soil with organic matter?
6. What are the effects of too much organic matter for sweet potatoes?
7. Review cover-crop job in corn enterprise.

Activities.—Collect specimens of winter cover-crop plants. Find rate of seeding used in each case.

Job 5. Selecting the Variety to Plant

Conditions Usually Found.—(1) Not enough attention is given to this phase of sweet potato growing in most sections, especially where the crop is grown on a

small scale and for local markets. (2) The commercial grower generally uses the variety demanded by his market.

Aims.—(1) Growers should know the best varieties for home use and for commercial use. (2) Differences between varieties should be understood.

Problems for Study and Discussion.—(1) Make a survey of the potatoes grown in your community and determine what varieties are grown.

2. List varieties grown for market, also in case of those for home use.
3. Determine the most popular variety for each purpose.
4. Make a study of the market demands regarding varieties.
5. Which varieties ship best?
6. What changes have been found recently in market demands?

Activities.—Collect sweet potatoes of as many varieties as possible. Practise identifying and describing to bring out characteristics.

Market Varieties.—If the crop is to be marketed coöperatively, it is very necessary that all grow the same variety and strain.

For Storage and Shipping purposes the Porto Rico and Nancy Hall are the most popular varieties. Market popularity should be the basis

Fig. 192.—The thrifty appearance of this sweet potato project shows evidence of sufficient organic matter and plant food in the soil. (P. L. Trent.)

of selecting between these two varieties. If the sweet potatoes are grown to be sold "green" on the early market, the Triumph and Big Stem Jersey are probably the best varieties. In any case only a pure strain of the variety should be used.

Northern Markets usually prefer dry mealy sweet potatoes of the Jersey type. The Big Stem Jersey is much grown for this market.

If possible a marketing specialist should be consulted in choosing the variety to be grown.

Varieties for Home Use and Local Market.—Many who grow sweet pototoes for home use may have a surplus for sale to local dealers. If the crop is to be marketed locally, valuable suggestions regarding varieties may be had from local dealers.

Job 6. Securing Seed and Growing Plants

Conditions Usually Found.—(1) Where sweet potatoes are grown for home use in the southern states, the seed potatoes are generally saved from the previous year's crop. (2) A few farmers still save for seed the small ill-shaped roots that are unfit for human food. (3) In some cases the plants are bought from a commercial plant grower. (4) In growing plants or buying them not enough attention is usually given to disease prevention and to the type of sweet potato.

Aims.—(1) Each grower should be able to secure seed or plants for his enterprise from economical and reliable sources. (2) He should know the value of seed that are absolutely free from diseases and insects. (3) The value of treating seed should be understood.

Problems for Study and Discussion.—(1) Determine the methods used by the sweet potato growers of your community in securing their plants.

2. If the plants or roots are ordered, get a list of the reliable dealers.
3. What troubles are spread from the seed?
4. Why should seed be treated before bedding?
5. Ask growers regarding the quantities of seed necessary for given areas.
6. What is meant by certified seed?

Activities.—(1) Compare average seed roots from different growers. (2) Find diseased roots. (3) Practise making beds and bedding sweet potatoes.

Saving Seed.—If good seed sweet potatoes have been saved from the previous year's crop, and have been properly handled, the job of securing seed is settled. In case roots are to be purchased, only reliable dealers should be consulted. It is best to pay a good price and get good seed. Money invested in good seed is always well spent.

Often the most economical plan is to bed the sweet potatoes and grow your own plants. If, however, it is necessary to buy plants, get them from reliable growers having inspected beds.

Examining and Treating Seed.—In selecting seed for bedding, care should be taken to use only healthy, smooth, medium-sized potatoes. Before bedding, each root should be examined for rot. This may be done by splitting the ends of suspicious looking ones and examining for discoloration. If the ends are blackened, the root should not be used for seed. Sweet potatoes that have circular, sunken, black spots on the surface should be discarded.

Before seed are bedded they should be treated for surface-borne diseases. The best method for doing this is probably to soak the seed from five to eight minutes in a solution of formaldehyde. Use one quart of 40 per cent formaldehyde to fifty gallons of water. It is most convenient to put the roots in sacks in quantities that can be easily handled. They may be easily dipped into barrels or tubs containing the solution. If the seed have been treated they should not be allowed to come in contact with sacks or other containers that have not been thoroughly disinfected with the above mentioned solution.

Bedding Sweet Potatoes in Hotbeds.—If plants are to be grown, the bedding should be done several weeks before the date of the latest

spring frosts. Plants are often grown without artificial or manure heat in most of the southern states. If however, early plants are desired a hotbed should be used (Fig. 193). The following points should be considered in the preparation and care of the bed, according to the South Carolina station:

1. Locate the bed in a southeastern exposure, with protection from the wind if possible. The bed should be in easy reach of water; should be in a well drained place; and preferably in new land and land free from diseases. If there is any likelihood of the soil being infected with disease, it is well to use clean sand instead of soil. Wide boards should be substantially placed around the bed.

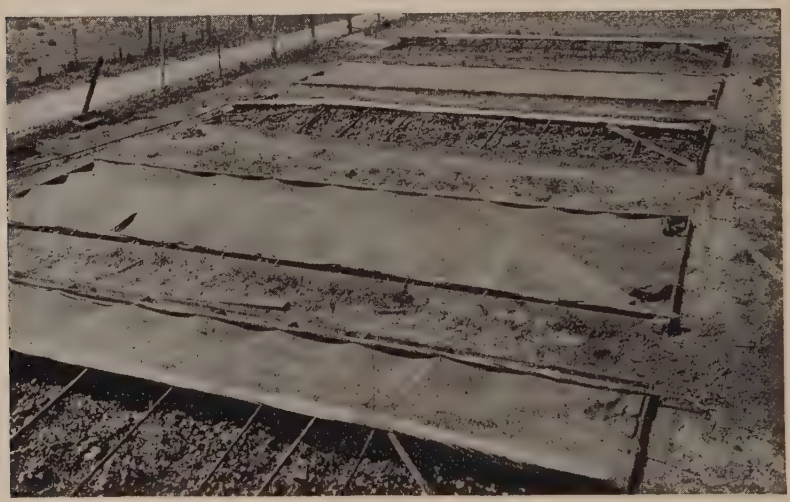

FIG. 193.—Hotbeds for growing sweet potato slips. Madison, Florida, High School. Each bed is 32 by 11 feet and holds 15 bushels of seed. (Mitchell Wilkins, Instructor.)

2. Break the land and scoop out three or four inches of soil. Make the bed much deeper in cold regions. Make the bed rectangular, not over four feet wide, and of a length to accommodate the amount of seed to be bedded. One bushel of average-sized potatoes requires from ten to twelve square feet of space and will produce about 1000 plants.

3. Mix approximately half-and-half of cotton seed and fresh horse manure for heat. Use a layer of this mixture approximately four or five inches deep. Level, pack and sprinkle with water if the mixture is dry. Cover this with two to three inches of clean sand. To prevent overheating, allow the bed thus formed to remain twenty-four to thirty-six hours, depending upon weather and age of manure, before bedding.

4. The sweet potatoes should be bedded immediately after treating. Do

not allow them to touch each other. Cover them with a one-inch layer of pine straw or similar litter and cover this with an inch of sand, and when sprouts appear add 3 to 4 inches more of sand. The straw prevents pulling the seed out of the ground when plants are pulled. The last application of sand gives strength to the plants.

5. Bed 3 to 4 bushels to produce enough plants for each acre if three pullings are to be made. Otherwise 6 to 8 bushels are needed. In other words, three bushels will ordinarily produce 10,000 plants in three pullings. If vine cuttings are to be used on a part of the acreage, fewer seed are needed.

6. Use light cloth, heavy muslin, or glass over beds, to protect plants from frost.

7. Pull plants often to encourage production.

8. Keep the plant bed well watered. Care should be taken, however, not to allow the bed to become soggy. Two inches of straw loosely thrown over the top sand or soil is good to prevent soil-baking, water-packing and mild frost injury.

Growing Enough Plants.—After the acreage to be planted and the distance apart of the plants have been decided, the number of plants required can be determined. This will make it possible to know rather accurately just how many potatoes to bed. The general practice is to bed one bushel of seed potatoes for each thousand plants desired at the first drawing. One bushel will usually produce three to four thousand plants at three drawings. These figures are rather conservative. Plants may be grown for approximately one-fifth of the area to be planted, vine cuttings being used for the remainder. It is best to use the single-leaf cuttings from eight to ten inches long. Sweet potatoes produced from vine cuttings are smoother and more uniform than those grown from slips. This gives a greater percentage of marketable potatoes.

In most sections of the South sweet potato plants for the main crop may be produced in unheated beds. The bed should be in a well drained place and on the south side of a building, or similiar protection. This bed should be five to six feet wide and as long as needed. Remove the soil to a depth of five to six inches, then put in about four inches of sand or loose loam and level. Place the sweet potatoes on this, leaving a little space between them. Cover the seed with one inch of sand or loose loam. Straw or leaves may be placed over the soil to hold moisture and protect from cold. The bed should then be thoroughly watered. Cloth covers may be used if the climate or season require this. If glass is used some sun heat will be trapped and the bed will be warmer. When the plants begin to show through the surface, add one to two inches of sand or loam.

Flue-heated Beds.—If it is desired to use a flue-heated bed, it may be constructed by digging a trench three to four feet wide and the length of the bed to be constructed. Flue-heated beds should not be more than

one hundred feet long. Flues should be placed in the trench thus formed and connected to stove or furnace. The side walls for a permanent bed are made of brick, stone or concrete, but a temporary structure of wood may answer the purpose. The furnace or stove should be so placed that it may be fired from the outside or just inside of a door opening into the space beneath the bed. Six-inch chimney tiles are best to use for the flues. These may run the entire length of the bed or discharge the heat through the open space beneath the floor of the bed twenty-five to thirty feet from the entrance. A chimney with good draft is placed at the end of the bed to collect the gasses and smoke and carry them to the open air. The floor of the bed is usually made of boards supported or temporarily placed across the bed. From four to six inches of sand or loose loam is placed on the floor and sweet potatoes are bedded on this.

Type of Bed to Use.—If sweet potatoes are to be grown for early market, manure-heated or flue-heated beds should be used. These beds should be covered with glass or waterproof cloth. This practice not only provides early plants, but the plants are larger and more stocky.

The grower, in determining the type of bed to be used, should have in mind the cheapest and most economical method. The purpose for which the potatoes are to be grown is probably the most important factor in determining the type of bed to be used.

Job 7. Selecting and Applying Fertilizers and Manures

Conditions Usually Found.—Fertilizers are often selected without consideration of the cropping system, conditions of the soil, plant requirements and other data.

Aims.—Growers should determine, in case of each project, the sources, amounts, and times of application of phosphorus, nitrogen, and potash.

Problems for Study and Discussion.—(1) Ask local growers what fertilizers they buy for sweet potatoes.

2. How many of them buy ready-mixed materials?
3. How many of them buy separate materials for nitrogen or phosphorus or potash?
4. What amounts are used per acre?
5. When are fertilizers applied?
6. Describe methods of applying fertilizers for sweet potatoes.
7. Get opinions of best growers regarding improved methods of fertilizing.
8. What would you buy to supply ammonia or nitrogen? Phosphorus? Potash?

Activities.—(1) Collect a list of fertilizer materials used locally. (2) In a table write opposite each the kind of soil and the amount of manure and green manure used.

Considering All Factors.—The results of local studies should be considered along with station data. In addition to the conclusions thus reached, the condition of the soil and the cropping system in each individual field must be considered. For example, if legumes are grown on the soil less nitrogen is required in the form of fertilizer. Although sweet

potatoes respond to heavy fertilizing, they do well on less than other truck crops.

Kind and Amount to Use.—As a rule an 8–3–3 (P–N–K) fertilizer is recommended for heavy soils, and an 8–3–6 for lighter and poorer soils. From 40 to 60 pounds may suffice on rich soil that will produce one bale of cotton per acre. From 600 to 1200 pounds should be used on the lighter and poorer soils. (See Appendix.)

The latest recommendations of the nearest experiment station, along with local practices, should be followed. (See table on mixing in cotton enterprise.)

HOME–MIXING FERTILIZERS

Saves farmers money
Gives desired analysis
Furnishes crop needs
Supplies what soils lack
Avoids using filler
Uses desired ingredients
Gives satisfactory yields
Requires little labor
Promotes better farming

Applying Fertilizer.—The fertilizer should be applied one week or more before setting the plants. At the time of application it should be thoroughly mixed with the soil. The roots of the plants may be seriously injured by allowing them to come in contact with fertilizer in concentrated form.

The general custom is to apply the fertilizer where the row is to be, several days in advance of planting. This may be done with a one-row distributor. This implement merely sows the fertilizer and is followed by a plow to prepare the row. The type most used by sweet potato growers, however, opens a shallow furrow, sows the fertilizer, and throws up a slight ridge by means of a set of disks attached to the rear of the distributor.

Using Manure.—If the soil is deficient in organic matter, stable manure gives good results. The manure should be applied broadcast over the soil in the fall before the crop is to be planted in the spring, and should be thoroughly worked into the soil. It is much better, however, to use the stable manure on the crop that precedes the sweet potato crop.

Job 8. Preparing the Soil for Planting

Conditions Usually Found.—(1) It is a rather common practice merely to throw up ridges or rows without previous preparation of the soil. (2) A large number of growers do not prepare the bed far enough in advance of the time of transplanting plants.

Aims.—The student should be familiar with the best methods of soil preparation on his particular type of soil.

Problems for Study and Discussion.—(1) In what month do the farmers of your community prepare the field for transplanting?

2. How many of the growers practise fall preparation?
3. How many farmers use ridges? How many use level methods?
4. How is fertilizer applied at preparation time?
5. What preparation is made before the ridges are formed?
6. How are ridges formed and what implements are used?
7. What are the distances between rows?

Fig. 194.—Plowing soil with a tractor. Thorough work in this job pays later. (E. W. Garris, Fla.)

8. How long are the ridges allowed to settle before transplanting?
9. How many growers plank or drag down the ridges before planting?
10. How high are the ridges at the time of transplanting?

Activities.—(1) Measure the distances between rows and plants on different farms. Calculate the number of plants per acre in each case. (2) Compare efficiency of ridging machines and plows by timing the work of each.

Thorough Preparations.—The most common practice in the southern states is to plant the sweet potatoes on ridges. Level culture may be practised, however, if the land is high and well-drained. The soil should be thoroughly plowed and pulverized before the ridges are formed. It is well to harrow the soil repeatedly to put it in good physical condition. Not only does thorough preparation facilitate crop growth, but it provides favorable conditions for subsequent cultivation and handling of the growing crop. In this primary preparation, the soil should be made mellow to a depth of approximately six inches (Fig. 194). A very deep soil is not conducive to the production of a large percentage of marketable potatoes.

Fertilizing and Ridging.—Before the ridges are formed the soil should be allowed to settle well. The rows should be run from 30 to 48 inches apart, according to the fertility of the soil. The fertilizer is drilled in the rows and thoroughly mixed with the soil. The ridges may be formed (Fig. 195) by means of a turning plow or by special ridging machines. Allow the ridges thus formed to settle at least one week before planting. The ridges should be leveled down to a height of approximately four inches by means of a roller, plank, drag, or harrow. This height should be determined to some extent by the drainage and character of the soil. Low ridges make cultivation easier and more economical unless the season is very wet, and give as good yields as high ridges.

FIG. 195.—Ridging the land with turning plows, preparatory to planting the sweet potato crop. Ridges should be packed with planker or should be allowed to settle somewhat before planting.

Job 9. Transplanting Plants

Conditions Usually Found.—Transplanting is usually performed by hand on farms where only a small patch is planted. Commercial growers often use transplanting machines. The error made by a number of farmers is in not getting the soil firmly pressed around the roots of the plants. Farmers usually wait for a rain before transplanting.

Aims.—Students should know the most practical and economical methods to be used in each case. They should realize the importance of getting the soil in thorough contact with the roots or stems of the cuttings.

Problems for Study and Discussion.—(1) How far apart are the plants usually set on the various kinds of soil in your community?

2. How does this compare with experiment station recommendations?
3. What methods of transplanting are used by the farmers in your community?
4. Describe the work of a transplanting machine.
5. Get opinions of farmers regarding such a machine.
6. What are the most common transplanting dates for your section?

Activities.—Time workmen in setting plants by machines, by tongs, and by hand. Calculate how many acres must be planted to warrant the purchase of a machine.

Setting Plants Early.—Plants should not be set in the field until all danger of frost is past. Early planting is, however, highly recommended. For late planting cuttings may be taken from early-set vines. This saves the necessity of bedding large quantities of seed but the yields are too late for early market. In some sections of the southern states fair yields are made when plants are set as late as the last of June or the first of July. In most sections of the cotton belt transplanting may be done as early as the first or middle of April.

Planting by Hand.—If the ground is in good condition the plants may be pushed into it with a forked stick and the soil pressed to them with the foot. If the soil is dry, water must be used. A hole is dug by means of a hoe, and a little water poured in after the plant is set. Ordinarily, a

Fig. 196.—Vocational students planting sweet potato slips. Madison, Florida, High School. Rows are 3½ feet apart and plants 18 inches apart in rows. (Mitchell Wilkins, Instructor.)

pint of water is all that is necessary. Loose, dry soil should be placed around the plant after it is set to prevent baking and evaporation. It may be better to use this method than to wait for rain. Care must be taken to get the soil pressed firmly around the roots (Fig. 196).

Machine Planting.—When a large acreage is planted in sweet potatoes it is profitable to employ a transplanting machine. It sets and waters the plants as fast as the team pulls the machine.

It is recommended that the plants be set 14 to 18 inches apart in the rows. The distance, however, is influenced by the variety and the fertility of the soil. Close spacing gives a more uniform lot of roots, which is very desirable in case the crop is to be marketed.

Job 10. Cultivating the Crop

Conditions Usually Found.—Sweet potatoes are cultivated about as cotton and corn.

Aims.—The best methods of cultivation should be understood and practised.
Problems for Study and Discussion.—(1) Secure information from your neighbors regarding the following practices: (a) Frequency and number of cultivations. (b) When is the first cultivation given? (c) What implements are used? (d) Depth of cultivation. (e) Methods used in turning the vines.

Early Tillage.—To correct the packed condition of the soil brought about by the transplanting processes, the soil should be cultivated immediately after the plants are set.

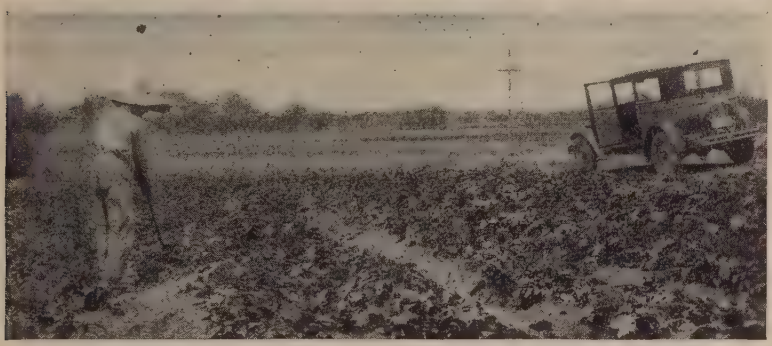

FIG. 197.—While the vines are small, sweet potatoes may be readily cultivated.
FIG. 198.—A little hand work is quite necessary in moving the sweet potato vines for a late cultivation.

Frequent Cultivation.—The tillage should be frequent and shallow, and should continue until the vines have covered the surface. Cultivate every ten days or two weeks and after each rain. While the plants are small (Fig. 197), the most satisfactory implements are those forms of one-horse cultivator equipped with small points so as to be run as near as possible to the plants without covering them with soil. As the plants grow larger, a scrape cultivator or any other implement doing shallow work is suitable. The scrape may be especially desirable because it moves under the vines without bruising them.

Moving Vines.—Just before each cultivation, if the vines have begun to run, they should be turned into alternate middles with a stick, (Fig. 198) to get them out of the way of the cultivator. At the next cultivation, the vines are raised. Some cultivators are equipped with vine-lifting attachments, which make it unnecessary to move the vines by hand.

Job 11. Controlling Enemies

Conditions Usually Found.—Growers have greatest losses from black rot and stem rot, and often do not use control measures. Other troubles are seldom prevented.

Aims.—Students should know the injury of each of these enemies, and how to control them.

Problems for Study and Discussion.—(1) Detect the common enemies in your community. (Fig. 199.)

2. What ones give serious trouble?
3. What enemies have occurred only occasionally?
4. What control or preventive measures are used by the farmers against black rot and stem rot?
5. How may the use of cuttings be helpful in controlling stem rot?

Activities.—(1) Collect vines and roots showing diseases and work of insects. Practise identifying the work of each enemy. (2) Treat sweet potatoes for bedding as directed.

Stem Rot.—Usually the plants show a variation in color from the normal, the leaves turn dull, then yellow between the veins, become somewhat puckered, and finally wilt.

Control.—Select disease-free seed. Before bedding, split the stem end of the sweet potato a little way. If darkened, the root should be discarded. Select roots that have been grown in uninfested soil. Rotate the crop, as the disease is carried over in the soil as well as in storage. Treat seed with corrosive sublimate before bedding, one ounce to 8 gallons of water may be used. Soak roots for 15 minutes. Healthy plants in young stands should be chosen, and cuttings made from these to set in the field.

Black Rot.—This disease shows up in the sweet potato as sunken, more or less circular, dark or nearly black spots.

Control.—Use the same measures as for stem rot. Also destroy slips showing black spots on the white surface. Soak seed potatoes for 5 to 8 minutes in a solution of formaldehyde, made by adding one quart of the commercial solution to fifty gallons of water (Job 6) or use the corrosive sublimate treatment suggested above.

Soft Rot.—This is the most common storage disease and is largely caused by mechanical injuries, which permit the entrance of the disease fungus. This disease may therefore be largely prevented by careful handling, by keeping all injured potatoes out of storage, and by uniform storage temperatures.

Root rot is prevalent in the southern states, chiefly in Texas, New Mexico, Oklahoma, and Arizona, and is not found in the northern states. It varies considerably in the amount of damage it does. In some cases where the disease has secured a good foothold in a field as high as 90

FIG. 199.—This vocational student is examining his sweet potato vines for any lurking enemies—either insects or diseases. (P. L. Trent.)
FIG. 200.—Investigating his sweet potato project to see if it is ready for early market. (M. B. B.)

per cent of the crop may be destroyed, while in other fields the damage may be much less. It may occur over certain areas in a field, and frequently not all the sweet potatoes are infected in the hill nor all the hills destroyed.

In the South, the organisms live in the soil from one season to the next but are killed by hard freezing; this is probably the reason the disease is not found in the northern states. It gains access to the plants on the underground parts and spreads to both vines and roots. On the sweet potatoes, it may enter the root or cause spots on the surface. The infection grows as a brown rot and finally destroys the sweet potato. Infected stems show a brown discoloration beneath the surface. The disease also attacks other plants, especially cotton and alfalfa, and this makes it difficult to control.

The best preventive measures are deep and clean cultivation, crop rotation, and careful seed selection.

The sweet potato leaf folder is another pest of this crop found in the southern states, chiefly Louisiana and Texas. It is a moth; the damage to the plant is done by the larvæ, which feed on the leaves of the plants.

Experiments conducted by the U. S. Bureau of Entomology indicate that larvæ can be killed readily by spraying the foliage with either arsenate of lead or arsenate of lime at the rate of 1 or 2 pounds (powder) to 50 gallons of water.

The sweet potato weevil is the most serious pest found in the southern states bordering the Gulf of Mexico. This is a slender, metallic-blue weevil about one-fourth of an inch in length, with red legs and thorax. The adults injure the sweet potato by feeding on the leaves, vines and roots, and the larvæ burrow into the roots, causing tunnels that spoil the sweet potatoes. The ravages of this pest are severe and its control difficult. In fact, the pest is so destructive that it threatens to destroy the sweet potato industry where it has secured a foothold.

Control measures advised by the U. S. Department of Agriculture follow:

1. Do everything possible to prevent the transportation of weevil-infested plants to uninfested districts.

Do not use for planting seed sweet potatoes, slips, or draws from weevil-infested localities, but obtain them from localities in which the weevil positively does not occur.

2. Never use the same land for growing sweet potatoes year after year where weevils are present. Rotate with cotton, corn, tobacco, Irish potatoes, peanuts, or any other profitable crop.

3. Harvest promptly and thoroughly, gathering all tubers or roots.

In infested regions sort tubers into three lots: (a) Those which are practically weevil-free, for storage; (b) those which are moderately infested, for fumigation and early consumption; (c) those which are too badly weeviled, or otherwise injured for food, to be cooked for stock or burned.

4. Disinfect all weevily roots, wherever advisable and practicable (e.g., when soon to be eaten), with carbon bisulfid or other fumigant.

5. Destroy the weevils in badly infested and inferior roots by cooking and then feed to hogs, poultry, or cattle. Even if the infested roots are so badly damaged as to be bitter they may be fed if mixed with other feed for hogs.

6. After cleaning up the culls, vines, remnants, and rubbish remaining in the fields after harvesting, burn them promptly and thereafter keep the fields clean at all times.

7. Keep down volunteer sweet potatoes and all plants of the morning-glory family, whether cultivated or wild.

8. Plant the new crop remote from the seed bed.

9. Spray plants with arsenicals for first-appearing weevils on leaves and stems. Dip the slips and other propagation material into arsenate of lead before planting. Kill the beetles before egg laying begins and whenever they appear in numbers.

10. Observe care in storage, keeping tubers dry at all times to prevent secondary injury from rots.

11. All states in which the sweet-potato weevil occurs have adequate crop-pest laws which permit the establishment of both interstate and intercounty quarantines against this pest. Close coöperation with state and federal authorities will be advantageous to growers in reducing losses from weevil attack. It is especially urged that commercial plant growers provide certificates of inspection for weevils when shipping plants or seed potatoes for planting, and that all growers who purchase planting stock insist that a certificate of inspection be furnished. Aid the enforcement of the quarantine laws.

The Root Borer.—This is the most serious insect pest of the sweet potato. It works under ground and bores tunnels through the root, making it unsalable.

Control.—Do not use infected seed. Your state entomologist will assist in this matter.

Cutworms and army worms very seldom give much trouble. They can be destroyed by use of poison bait. Use 20 pounds bran, 1 pound Paris green, 2 quarts syrup, 3 lemons, and about 3 gallons of water.

Job 12. Harvesting, Grading, and Selecting Seed

Conditions Usually Found.—Some crops are injured by not being harvested until after a killing frost. Sweet potatoes are not handled as carefully as they should be in many cases. When grown commercially they are usually well graded in the field. When grown for home use and for small local markets, very little grading is done. The separating of injured roots from the others is often not done.

Aims.—Each student should decide definitely just how he is going to harvest his crop. He should employ the best and most economical method in harvesting and grading. A thorough knowledge of grades must be obtained. The importance of care and accuracy should be stressed.

Problems for Study and Discussion.—(1) What methods are used by the farmers in your community in determining the time to harvest?

2. When are the potatoes harvested with reference to killing frosts?

3. What implements are used in harvesting the crop?
4. How is the labor distributed in harvesting?
5. What losses or injury to roots occur in harvesting?
6. How long are the potatoes left in the field after digging?
7. When, where and by whom is the grading done?
8. Outline a plan for selecting seed roots at the time of harvesting the crop. What methods are used by growers?
9. What use is made of culls and injured potatoes?

Activities.—(1) Collect specimens injured by bad handling. (2) Drill and become skilful in grading according to standards. (3) Select ten or more hills for seed.

Harvesting the Green Crop.—Since the price is much higher during mid or late summer, a portion or all of the crop is sometimes harvested green. The sweet potatoes are dug as soon as they reach marketable size (Figs. 200 and 201). This practice somewhat reduces the yield, but this sacrifice is usually justified by the high prices. In this case the sweet

Fig. 201.—A hill of good sized uniform sweet potatoes.

potatoes are dug, graded, crated and sent direct to market. The cost of handling is reduced by this method. If, however, the early market prices are not very good, it may pay to store.

Harvesting the Mature Crop.—The bulk of the crop grown commercially or for shipment to distant markets is put on the market as cured sweet potatoes. When grown for this purpose the crop is not dug until it is mature. When roots are mature, a broken or cut surface will heal over with a whitish appearance. If the broken surface becomes discolored the root is usually not mature. Another sign of maturity is the yellowing of vines, though this might be caused by disease.

Harvesting should be done while the ground is dry and before freezing weather. Sweet potatoes containing an excess of moisture and sap from frozen vines do not keep well in storage. The freezing of vines and roots also injures the eating quality of sweet potatoes. In case the vines are killed by frost before harvest they should be left on as a mulch and the crop dug as soon as weather permits.

The methods of harvesting and the implements used will depend upon the area to be harvested. Turning plows with colters are most commonly used in cases where the crops are grown for home use or small markets. Where larger crops are grown special plows and machines for digging are used. In some sections vine cutters are run over the rows in advance of the plows.

Each pupil should determine the best implement to use under his conditions. He should also try to use the most economical method. It is not necessary to buy expensive machines. Suitable implements may be found on almost every farm. If the student is a "handy man," he can attach a colter to the ordinary turn plow and dig his potatoes satisfactorily.

Probably the best method is to bar off the middle with a turn plow and then use a middle burster in throwing out the roots. Special care should be exercised not to injure the sweet potatoes any more than necessary.

Handling the Crop.—After the roots are dug their surfaces should be allowed to dry for a short time. If the sun is not too hot a good practice is to dig in the morning and take up the sweet potatoes in the afternoon. They should never be allowed to remain in the field over night. The crop should not be very long exposed to the hot sun. The soil should be as dry as possible during harvest.

It is a bad practice to throw the roots carelessly into large piles, as bruising makes them more susceptible to disease and reduces the percentage of marketable product.

Grading.—It is probably more economical to do the grading in the field. This reduces labor in handling the crop. Go over the field and pick out the marketable sweet potatoes. Then cheap labor can be used in picking up the culls and injured ones. Market grades have been defined. A set may be procured from the department of markets or your agricultural college. They should be used as the basis for grading. The sweet potatoes may be placed in hampers or lug crates and later collected by wagons and hauled to the place of storage.

Selecting Seed.—It is well to select seed for next year's crop during the time of harvest. Careful seed selection aids greatly in controlling diseases, increasing yields, and improving the type.

Seed should be selected just after the crop has been plowed up and before other handling. The grower should have throughly in mind the ideal type, the most desirable size and shape, for the purpose for which the product is to be used. Seed selected should be from the most productive hills, and free from disease and injuries of any kind. A variation in stages of maturity of different hills will be found. Seed from the most mature hills will grow better. Seed thus selected should be kept separate from the remainder of the crop and should be handled as little as possible.

Job 13. Curing and Storing Sweet Potatoes

Conditions Usually Found.—The most common practice among farmers growing sweet potatoes for home use and for small local markets is the bank or hill method of storing. Many growers market at harvest time. Many commercial growers successfully use standard storage and curing houses of the U. S. Department of Agriculture plan. Errors in curing and storing often occur which result in large losses.

Aims.—Each student should determine the best and most economical method of caring for and storing his crop.

Problems for Study and Discussion.—(1) Make a thorough survey of the methods used in curing and storing sweet potatoes in your community.

2. Determine as accurately as possible the cost per bushel in each method.
3. Find the results of each.
4. Make special study of the methods used by the most successful growers.
5. Try to get the average market prices of sweet potatoes handled by the various methods.

Activities.—Draw plans of a storage house. Make list of materials for this. Estimate cost of building. Draw up a contract form for growers to sign for the erection and using of the house.

Banking the Crop.—In most of the southern states where sweet potatoes are grown for home use and for small local markets they are usually stored over winter in conical banks or mounds. These banks may contain from 15 to 30 bushels of roots. This is a fairly satisfactory method if the banks are properly constructed and well managed and the roots are free from disease.

Banks constructed as follows ordinarily give as good results as might be expected, but never are as safe as the house: (1) Cut a small trench around a well drained, somewhat sheltered spot. (2) With the earth thus removed, build up the ground on which the heap is to be made. (3) Place a layer of dry straw over this. (4) In the center, stand a flue ventilator made of four boards approximately eight inches wide. Bore holes in this upright 3 or 4 inches apart. (5) The roots are then carefully placed around this ventilator. (6) Cover the roots with pine needles or clean, dry straw. (7) A layer of corn stalks is then placed over the straw to support an outer covering or layer of soil which at first is of not more than 1 or 2 inches. (8) A few weeks later, after the sweet potatoes have gone through a sweat and before cold weather, increase the layer of soil over the corn stalks to about 3 or 4 inches. During very cold weather the top of the ventilator should be stopped with an old sack or something similar. A cap for the mound may be made of boards to hold soil.

Small quantities of sweet potatoes may be cured and stored in small boxes or crates in the basement near the furnace or in the loft over the kitchen.

Regardless of what method is used, the important thing is to keep the crop in a dry atmosphere, and at a warm, uniform temperature. Always store in boxes, barrels or crates—never in sacks.

Storage Houses.—If large quantities of sweet potatoes are to be cured and stored, a specially built storage house should be provided (Fig. 202). Before going to the expense, however, the situation should

FIG. 202.—A well-ventilated storage house for sweet potatoes, used by one community. The crop is cured by heat from stoves in the house.
FIG. 203.—In curing sweet potatoes the ventilation must be carefully controlled. These students are taking good care of their crop.

be thoroughly studied from every angle. There are a large number of cases over the country where storage houses have been built and used only a few times. Houses are unsuccessful if poorly managed.

Curing Sweet Potatoes.—Some natural or artificial drying is essential to artificial storage. Stoves are used in storage houses, for a period

of about two weeks. Warm air must circulate freely among the roots. They should go through a sweating process at a temperature of perhaps 85 or 90 degrees. F. A few weeks later the temperature is gradually lowered to 60 degrees, or a little less. If the ventilation is good the potatoes may be held at this temperature for several months.

Storage houses are usually constructed and used coöperatively by small growers (Fig. 203). This method is very satisfactory in some sections, but the individual house is often the best.

Tobacco barns are sometimes used for curing and storing sweet potatoes. Abandoned tenant houses and other unused buildings may be put in condition for use.

If a storage house or a tobacco barn is to be used, U. S. Farmers' Bulletin 970, "Sweet Potato Storage," should be studied. This bulletin gives detailed information as to the construction of storage houses and their management.

Job 14. Marketing Sweet Potatoes

Conditions Usually Found.—The southern states produce the greatest portion of the sweet potato crop, yet only a small part of this crop is shipped to distant markets. The majority of the southern farmers do not appreciate the necessity for careful grading, packing and curing. Marketing is done chiefly on local markets.

Aims.—Students should be able to market their crops to the best advantage and should understand the best methods of other growers.

Problems for Study and Discussion.—(1) Determine the quantity of sweet potatoes marketed from your community for the last few years.

2. On what types of markets are these sold?
3. How are they prepared for each type of market?
4. Compare the prices received in case of each marketing method.
5. Describe methods of coöperative marketing or shipping.
6. What factors are most important from the standpoint of success or failure in the marketing of sweet potatoes in your community?

Activities.—(1) Collect containers of several types for marketing sweet potatoes. (2) Write to a marketing association or otherwise obtain by-laws for coöperative marketing.

The market values of sweet potatoes are greatly affected by methods of digging, curing, and preparing for market. A good crop of sweet potatoes may lose a large part of its market value by the lack of proper grading and packing. The product should not only be properly graded, but should be carefully and neatly placed in attractive containers. The containers should be bright, clean, new and well constructed. Money spent for good containers is well invested.

Hampers, baskets, and crates having the capacity of a standard dry bushel are the most commonly used containers. Crates have an advantage if a storage house is used, as they stack well and can be easily handled. If barrels are used they should be of legal size. Barrels are preferred in

selling green crops on the early market. Never handle sweet potatoes in a bag, as they are not protected and become bruised.

The student or grower having sweet potatoes for market should keep well posted as to the daily market. Price reports are issued daily, and may be had by writing the Bureau of Markets, Washington, D. C. This Bureau also furnishes trained inspectors and graders in the larger shipping points. Any shipper may secure the service of these experts. Their functions are to supervise grading and to inspect the shipments when they arrive in the markets, and give an official report of their condition.

Members of agriculture classes should ship their crops coöperatively. The total marketable sweet potatoes grown by students and other farmers should be sufficient to fill at least one car. Plans should be made to this end before the projects are started.

In most sections of the South, green or early market sweet potatoes should be on the market by August 1, as the price generally drops seriously after this time.

Agricultural agents of the various railroads are willing and anxious to coöperate with vocational agricultural classes in locating markets and marketing potatoes.

In most sections of the South agricultural classes, through organized activity, may grow and market potatoes in car-load lots. Even though sweet potatoes are not among the main money crops of a given community, a small acreage may be grown by each student as a side line, and the yields stored and shipped coöperatively. This may give the students a chance to convert spare time into money.

Job 15. Summarizing Cost Records

(See analysis of record keeping and record forms in corn enterprise.)

By having an accurate record of all costs and returns in a sweet potato project, each grower can determine his profit. The net profit per acre should be determined, also the profit per hour of the grower's time in producing and disposing of the crop. It is interesting to compare this labor return with that of other crops grown by students or farmers.

The following example is given to show how the sweet potato enterprise may be analyzed.

These data were collected and prepared by S. P. Harris, a student in the department of agricultural education at Clemson College, South Carolina.

SWEET POTATO COSTS PER ACRE, ONE YEAR

ITEMS	QUANTITY INPUT	COST IN DOLLARS
Man hours	113	$22.67
Mule hours	50	7.62
Machinery, use, hrs.	50	0.49
Seed and plants		5.79
Fertilizer, mixed, lbs.	470	8.67
Manure, lbs.	5088	2.85
Barrels, baskets		.40
Insurance		.16
Operating capital		1.00
Tractor, car		14.87
Total, other than rent and interest		$64.52
Rent		5.30
Interest on mule and equipment		.22
Total net cost and rent and interest		$70.04

Yield in bu. per acre (5-year average, Oconee County)	68
Value of sweet potatoes per bushel (5-year average, S. C.)	$ 1.16
Value of sweet potatoes per acre	78.88
Cost per acre without grower's labor	47.37
Net wages per acre	31.51
Net wages per hour ($31.51 ÷ 113)	0.28

Things to Make at Home.—Make crates in which to store sweet potatoes; repair or help build storage house; build ventilator on storage house; make metal screen for stove used in curing house.

References.—Experiment station publications on sweet potatoes: Alabama, 220; Circ. 90; California, Circ. 285; Delaware, 114, 127; Georgia, 209, 312; Maryland, 59, 60; Mississippi, 190, 206, Circ. 18; New Jersey, 51, 365, 398, 401, 433; Circ. 114, 141; South Carolina, 84, 556; Circ. 41, 83; Virginia Truck Station, 39, 40; Texas, Ext. Circ., C 18. U. S. Dept. Agr., Department Buls. 1021, 1063, 1158; Circ. 99; Yearbook 1925.

TOBACCO ENTERPRISE

By Forrest G. Burd, B.S.

(Assistant State Supervisor Agricultural Education, Kentucky)

Analysis into Jobs.—The following jobs include the main units in growing and marketing tobacco. References are made to U. S. Farmers' Bulletins. See also *The Tobacco Leaf* by Myrick and Killebrew.

1. Determining possibilities with tobacco. 571.
2. Choosing the soil, field, and area. 571.
3. Choosing type, variety, and strain. 416.
4. Growing a cover crop and providing organic matter. 579.
5. Procuring and treating seed. 571
6. Selecting site for seed-bed. Sterilizing plant-bed. 996.
7. Preparing seed-bed. Sowing seed.
8. Covering plant-beds. Caring for beds.
9. Preparing the field for planting. Fertilizing the plants.
10. Transplanting.
11. Cultivating the crop.
12. Controlling enemies. 571, 819, 846, 1352, 1356, 1425, 1489, 1494.
13. Choosing seed plants. Topping. Suckering.
14. Pruning.
15. Preparing the house and equipment for housing. 523.
16. Harvesting and scaffolding. 523.
17. Curing tobacco. 523.
18. Stripping. Grading. Bulking. 523.
19. Marketing.
20. Keeping records. 511, 572, 782, 1182.

Job 1. Determining Possibilities with Tobacco

Conditions Usually Found.—(1) Beginners are sometimes inclined to plunge into tobacco-growing when prices are high or to drop the enterprise when prices are low. (2) Most experienced growers realize that the raising and marketing of tobacco requires skill and hard labor.

Aims.—(1) Students should understand the dangers of price fluctuations. (2) They should learn to realize how technical knowledge and skill will aid in making tobacco-growing successful. (3) They should learn the suitability of the region, especially as to soil conditions, probable yields, profits, and labor involved.

Problems for Study and Discussion.—(1) Ask local growers regarding costs of producing and profits from tobacco.

2. What types of local soil are suited to tobacco growing?
3. Is the crop so exhaustive of soil fertility as to prohibit continuous growth of this crop? Get opinions of growers regarding this.
4. What local market conditions favor the disposal of the crop?
5. Find the price variations for grades grown locally during the past five years.

6. Is there a tobacco-marketing association in your locality? If not, why not?
7. Get opinions of farmers regarding such an association.
8. What would be the probable cost of equipping the farm with curing barn and any other special equipment necessary for handling the crop?
9. Make a list of growers who seem to encourage your undertaking this enterprise and list those who discourage you.

Activities.—Graph the prices of tobacco for the past five years, showing several grades. Tabulate the kinds and values of equipment on several farms.

In value, tobacco ranks as eighth crop in the United States. Over half the annual output is grown by Kentucky, Virginia and North Carolina. Kentucky alone raises about one-third of the annual production. Other producing states in approximate order of annual production are Tennessee, Connecticut, South Carolina, Pennsylvania, Ohio, Wisconsin, Georgia, Maryland, Massachusetts, Indiana, West Virginia, Florida, Missouri, and New York. (Figs. 204 and 205).

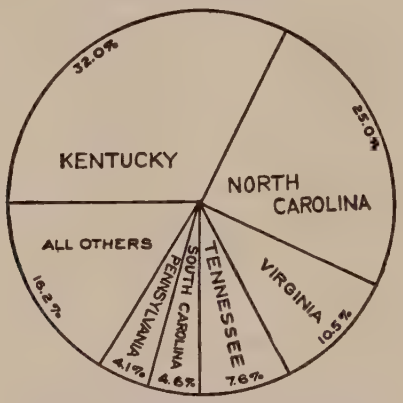

Fig. 204.—Production of tobacco in the United States. Percentages by states. 1922–1926 inclusive. (Chamberlain's Geography.)

Tobacco is also largely grown in British India, Russia, Hungary, Cuba, Argentine, Brazil, Japan, Dutch East India, Germany and Turkey.

From 1919 to 1923 the average annual world crop was 2,513,000,000 pounds. The United States produced two-fifths of this amount. The average yield per acre in this country is about 790 pounds.

In deciding whether or not to raise tobacco, there are certain factors to be considered:

(1) Will the market demands justify it?
(2) Are local soils suited for raising high-grade tobacco?
(3) Do the best farmers in the community encourage it?
(4) Will capital, labor and means for combating enemies warrant it?

Markets.—The use of tobacco is increasing each year; thus the demand, especially for smoking types, is growing. Because tobacco is a

money crop and seemingly very profitable, amateurs are likely to jump at conclusions and plunge into growing it under unfavorable conditions.

Perhaps the price fluctuations on tobacco are greater than those on other field crops. Generally speaking, the price is set by the buyers and the growers are too often at their mercy, somewhat independent of the rules of supply-and-demand. Being near a good market may cause more and better bids for good tobacco. The recent development of coöperative-

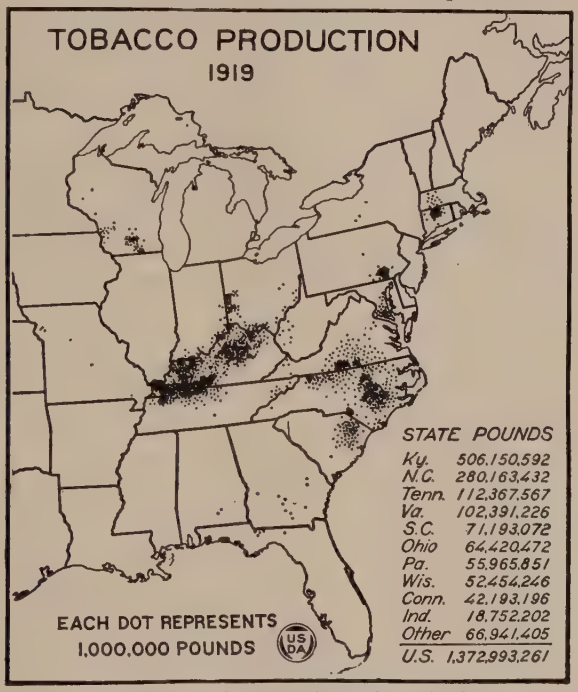

Fig. 205.—Tobacco-growing regions. Each dot represents one million pounds. (U. S. Dept. Agr.)

marketing associations has done a great deal to stabilize prices. Very superior quality usually brings good profits. Careful grading increases returns from a tobacco crop. Expert growers are often disappointed in prices, but on the other hand, tobacco farmers often receive returns beyond their expectations. It is a good plan to take the average per year to ascertain whether or not tobacco-growing in a particular community is a profitable enterprise.

Experience and Knowledge.—The production of no other crop requires more experience and care than does tobacco. Men who are

experienced in raising this crop and who have made a careful study of it say that its culture is just beginning to be understood. It requires a vast amount of work, some of which must be done almost every month during the year. Large yields of high quality increase the profit to be derived, thus a thorough knowledge of soil fertility, scientific training in tobacco culture, and diligent labor are factors in successful production.

Climate and Soil.—Not all regions are suited to the raising of tobacco. No plant is more easily modified by climate and soil conditions. Even climate is believed to impart flavor; soil determines texture. In deciding to raise tobacco, one should therefore determine from a chemical study of soil and from interviews with experienced growers whether or not his location is suitable for tobacco growing.

The soil should be fertile, but each type of tobacco requires a different type of soil. Clay loam produces heavy tobacco of the manufacturing type, while light soils produce cigarette tobacco and fine cigar wrappers.

The crop depletes soils, therefore it is well to observe crop rotation and the use of green manure and barnyard manure, else the growth of tobacco cannot be continued.

Kentucky, Virginia and North Carolina lead the States in the production of tobacco for several reasons. The soil in these States is peculiarly adapted to the growth of tobacco. The producers learned from their ancestors the method of growing a superior crop. Climatic conditions are favorable and experienced laborers are easily secured.

Labor and Capital.—A large capital is not necessary to produce a one-man tobacco crop if a suitable housing barn is already available. Housing room is the biggest item of equipment. A barn 24 feet square and 6 tiers deep will house about 1000 sticks of tobacco or one acre. The materials and equipment for combating enemies are not expensive. However, it is essential that the grower know the what, when, and how in the war against disease and insect plagues.

The wages paid for workers in this crop are not above the average paid for farm labor, but it is necessary that they be experienced in tobacco culture. In Kentucky, 35 days of 10 hours per day of man labor and 8 days of 10 hours each of horse power are required to produce one acre of tobacco. The average farmer with very little hired labor can grow from 3 to 5 acres of tobacco and keep other crops in proper balance.

The returns from tobacco may seem high, yet if cost of labor and equipment, including curing barns, is considered, the net profit may be small. Indeed the crop may easily show a loss. Under favorable soil conditions and skilful handling, however, tobacco is, on the average, a profitable crop.

Job 2. Choosing the Soil, Field, and Area

Conditions Usually Found.—(1) Experienced growers are able to make good choice of soils, fields and areas for tobacco. (2) Beginners are apt to make serious mistakes regarding these points. (3) Failure to consider the importance of preceding crops in the rotation is found among both experienced farmers and beginners.

Aims.—(1) Farmers should know how to choose suitable soils for the special kinds of tobacco to be grown. (2) They should also plan good rotations. (3) They should learn the factors involved in deciding on size of crop to maintain a proper farm balance in labor, capital and equipment.

Problems for Study and Discussion.—(1) Find the average acreage of a number of growers during the last five years. Report the average to the class.

2. What special local types of soil are used by local growers for tobacco?
3. What variations in this do you find? Explain them.
4. Find what authorities say regarding the types of soil for the tobacco grown in your region.
5. Explain why suitable rotations are important in tobacco growing.
6. Find what rotations are followed by local tobacco growers.
7. What typical rotations are recommended by authorities?
8. Plan the best rotation you can to suit local conditions.
9. Show how the acreage to be used for tobacco may influence the crop rotation to be followed.
10. How does the acreage of tobacco affect the farm balance regarding capital and labor involved?
11. Why should a beginner with small capital grow a small acreage of tobacco at first?
12. Show the relation of this to the amount of equipment necessary.

Activities.—Make a table with the names of several growers, the acreage in tobacco, crop which they prefer tobacco should follow, and type of soil preferred.

Choosing the Soil.—It seems that soil is more important in producing desired qualities in various types of tobacco than climate. Through the selection of a wide range of soils, many types of tobacco may be grown. All require soils rich in plant foods, so it is best to select either a virgin field or one that has been kept fertile through crop rotation or the liberal use of fertilizer. Sandy loams with a moderate amount of fertility produce a light tobacco of fine texture, which is the cigar and cigarette type. Heavy clay loams with a high degree of fertility produce a heavy coarse plant which is used for certain manufacturing purposes. Any field selected for tobacco should be suited to the type of tobacco to be grown. For all but cigarette types they may have a loose, open surface soil with good drainage but underlaid with heavy subsoil. Thus the moisture will be held and a steady growth through the season will result. Cigarette types thrive better with lighter subsoil. Too much organic matter in soils is harmful for flue-cured types.

Crop rotation is the most economical and desirable way to maintain soil fertility. It may sometimes be a better plan to depend on a large use of legumes, residues, and manure for nitrogen for dark tobacco than to supply nitrogen from commercial sources alone. Good rotations can be determined with the help of bulletins on tobacco culture and through

consultation with successful growers. At present, two rotations suited for dark tobacco are receiving particular attention by the Kentucky Station. They are as follows:

1. Clover, tobacco, corn, wheat.
2. Clover, corn, tobacco, wheat.

Crimson clover or rye is used as a cover crop after tobacco in the first rotation and after corn in the second rotation. The difference in the two rotations is in the relative position of corn and tobacco. Conditions based on these experiments indicate that tobacco following corn results in a better yield than tobacco after clover. (See Bulletin 228, Kentucky Station.)

Job 3. Choosing Type, Variety, and Strain

Conditions Usually Found.—(1) Many growers produce tobacco of too low a grade. (2) High grades of tobacco are usually most profitable. (3) Special types and varieties are suited to particular regions.

Aims.—(1) The importance of selecting the best types, varieties and strains to suit local soils and market conditions should be learned by breeders. (2) They should learn definitely which to grow for best results.

Problems for Study and Discussion.—(1) Ask several growers what type, what variety and what strain is grown by each, and why.

2. Compare the results of your inquiry and find what excuses are given where poor strains or varieties are grown.
3. Compare the prices per pound where different strains or varieties are sold.
4. Which types and varieties seem to suit the richest soils?
5. Why should wide-leaf tobacco be grown on rich soils?
6. What plans would you make in adapting the variety to your soil?
7. Why are some growers so much better informed than others regarding the use of different strains?
8. Why should a beginner study the strains thoroughly before planting?
9. Study the questions of labor and capital in connection with the different types of tobacco.

Activities.—Collect cured samples of each type, variety or strain that you can find. Mount these on heavy pulp board and label each.

Choosing the Type.—The chief factors to be considered in choosing the kind of tobacco to grow are (1) Market demands for the various types. (2) Adaptability of soil and climate. (3) Personal preference. (4) Character of equipment. One should be thoroughly familiar with the various demands for the different tobaccos before deciding upon a certain type to grow. Tobacco grown in the United States is divided into two classes, cigar class and manufacturing class. Both classes comprise several types of tobacco. The different classes are grown in different sections of the country, sold on different markets, and manufactured by different companies.

The cigar class is made up of tobacco suitable for cigar wrappers, binders and fillers. It is known that tobacco that has a relatively high

percentage of oil and wax does not make a pleasing cigar. Cigar tobacco must have good aroma and satisfying taste or else it will not sell on the market. Scientists tell us that there is much yet to be learned about how to grow and cure the cigar tobaccos so they will satisfy the smoker. Ohio, Pennsylvania, Wisconsin and Connecticut lead in the production of cigar tobacco.

The manufacturing and export dark tobaccos are usually those types that have a comparatively high percentage of oil and wax. They are air-cured dark tobacco, open-fire-cured dark tobacco, white Burley (air-cured: see Fig. 206), and flue-cured or bright tobacco. A large percentage of the manufacturing tobaccos is exported. This country manufactures plug, pipe tobacco, cigarettes and snuff from the manufacturing class. Kentucky, North Carolina and Virginia are the principal states that grow the manufacturing and export tobaccos. A distinct type of heavy dark tobacco is grown in the western part of Kentucky and in the adjoining States in the region that borders West Kentucky, and Virginia. Most of this particular type of tobacco is exported to Europe. The manufacturing and export tobaccos grow best on loam and sandy-loam soils rich in organic matter in regions where climatic conditions are conducive to rapid and continuous growth. Flue-cured types of tobacco do not demand soils rich in organic matter.

Job 4. Growing a Cover Crop and Providing Organic Matter

Conditions Usually Found.—(1) Tobacco growers often allow depletion of soils. (2) Many who realize the need of organic matter do not plan ahead long enough to provide it. (3) In most parts of the tobacco-growing regions winter cover crops are needed.

Aims.—(1) Students should learn the benefits of organic matter in the soil for such crops as tobacco. (2) They should learn the benefits of winter cover crops. (3) They should study the best ways of providing organic matter.

Problems for Study and Discussion.—(1) Ask local growers their opinions regarding the benefits of turning-under sod for tobacco.

2. What do authorities say regarding this?
3. Ask growers to compare the benefits derived from turning-under green manure or sod with light applications of barnyard manure.
4. Ask county agents or your experiment station regarding this.
5. Calculate the difference in amount of nitrogen derived from (a) four tons of barnyard manure; (b) a clover crop which would produce a ton of hay per acre.
6. Make a list of the benefits of organic matter in soils—to be written on the blackboard in the form of a chart.
7. If soil washes in the winter, why should a cover crop be used?
8. Make for blackboard use a full list of the benefits of winter cover crops.
9. How could you plan a rotation which would save growing a special cover crop on the field preceding tobacco?
10. Discuss the relation between soil depletion and the use of plenty of organic matter.
11. Calculate the cost of producing organic matter according to each of three

different plans: (a) barnyard manure; (b) sod in the rotation; (c) special cover crop.

Virgin Soils.—When tobacco is grown on virgin soils there is usually no need for the provision of organic matter. There may be enough native plant-food elements in rich virgin soils to meet the needs of the plants. When old fields are cultivated the grower may need to provide organic

FIG. 206.—A field of Burley tobacco in Kentucky in new woods land.

matter. Organic matter not only maintains a good physical condition of the soil but it contains elements of plant food required by tobacco.

Barnyard manure is a general source of organic matter. The fertilizing elements in manure are not readily set free, so it is advisable to apply it to the field in the fall or very early spring, and either harrow or disk it in. One ton of manure contains about 10 pounds of nitrogen, 8 pounds of potash, and 6½ pounds of phosphoric acid. The action of manure is slow; not more than 30 per cent of its fertilizing elements can

be used by tobacco the first year. It is always a means of improving soil since it supplies vegetable matter and soluble nitrogen and keeps the soil moist and loose. The application of manure is governed somewhat by the type of tobacco wanted. For dark tobacco it can be used in large quantities, but for Burley tobacco it should be applied lightly.

BARNYARD MANURE

Adds organic matter
Improves soil structure
Furnishes plant food
Unlocks plant food
Warms by aëration
Adds and feeds bacteria
Increases water absorption
Retards leaching
Reduces evaporation

Growing a Cover Crop.—If fields cultivated the previous year are to be used for tobacco they should be put in cover crops the preceding fall. Cover crops keep the land from washing in the winter and early spring. They also furnish pasture. Regions differ in their adaptability to various cover crops, but rye, crimson clover, winter vetch or some combinations of these is often used. Various types of tobacco require different kinds of cover crops. In the Burley tobacco section in Kentucky the best tobacco can be grown on blue-grass sod of several years' standing. In the "black patch" in the same state clover sods produce the best results. Cover crops not only make nitrogen available for the following crop, but they carry off surplus water and aërate the soil.

WINTER COVER CROPS

Preserve plant food
Keep soils busy
Open close soils
Regulate moisture
Reduce washing
Prevent leaching
Check wind erosion
Make winter pasture
Produce green manure

Job 5. Procuring and Treating Seed

Conditions Usually Found.—(1) Many growers select their own seed plants carefully, but some do not. (2) Very few farmers treat their seed before sowing. (3) Some serious diseases could probably be controlled by treating seed with corrosive sublimate.

Aims.—(1) The importance and methods of procuring good seed should be learned by tobacco growers (2) They should learn the importance and methods of treating seed before planting.

Problems for Study and Discussion.—(1) What practices are followed by local growers in procuring good seed and treating seed?

2. How can seed be removed from the seed cases so as to separate the poor from the good?
3. How can seed be graded with an air blast or fanning device?
4. Why should only the heavy seed be used?
5. Why is testing seed valuable? Describe how this is done.
6. Describe the treatment of tobacco seed with corrosive sublimate.
7. For what diseases is this treatment recommended?
8. Calculate the cost of treating seed.
9. Write the formula and directions for the corrosive-sublimate treatment in your notebook.

Activities.—(1) Set up the apparatus for sorting seed. (2) Practise sorting seed with blast of air. (3) Practise treating seed.

Securing Good Seed.—Some farmers choose to grow their own seed, others procure them from experts who make it their business to grow tobacco seed. The latter practice is becoming more popular. Growers are realizing that scientifically grown seed produces tobacco truer to type than home grown seed selected and cared for under the methods of the average farmer. It is also to the growers' advantage to procure seed from the expert if disease-resistant tobacco is desired. Very few farmers are willing to give the necessary time and care to produce standard seed.

Testing Seed.—The best way for the grower to know that his seed meet the standard desired is to treat them and test them out for himself. A simple germination test can be made as follows: Place a piece of dark cloth over a pie-pan, sprinkle some seed on the cloth, cover the seed with more of the same cloth, moisten well and turn a second pie-pan over the whole and place it in a warm room. In a few days the good seed will sprout and can be seen on the dark background; thus the percentage of germination can be determined. Tobacco seed, if properly stored, will retain the power to germinate for ten, twenty or more years; but it is never wise to plant old seed without first making the germination test.

Cleaning Seed.—Seed should be thoroughly cleaned before planting. All foreign matter and light chaffy seed can easily be removed with an air blast or with a fanning device. A simple device for cleaning seed can be made with a small foot bellows, two pieces of three-fourths-inch glass tubing three or four feet long, and two pieces of rubber tubing the same size as the glass tubing, six inches long. The glass tubing should be linked

together with rubber tubing and connected with the bellows with a piece of rubber tubing. By use of clamps the tubes can be fastened to the desk or wall so they will stand vertically. A small clamp should be fastened on the rubber tubing which links the two glass tubes. This is to keep the tobacco seed from running down into the bellows when poured into the upper end of the glass tube. One-half tablespoonful of seed makes about the proper amount to clean at one time. Place a small glass funnel in the upper end of the glass tube and pour in the seed. Start the bellows to working very slowly and gradually release the rubber clamp. Watch the seed and govern the blast accordingly. The chaff and light seed will be blown out of the upper end of the tube while the heavier seed will linger in the tube. When properly cleaned close the rubber clamp and remove clean seed from the cleaner. Repeat the process.

Treating Seed.—Since tobacco growers are constantly having to combat various diseases it is advisable to make a regular practice of treating the seed with corrosive-sublimate solution before planting. To treat seed, tie them in a clean bag and immerse them for ten minutes in a pint of water in which one small tablet of corrosive sublimate has been dissolved (one part to 1000). Rinse the seed well in clear water after treatment.

If the proper treatment is neglected tobacco will probably be more likely to be affected by angular leaf spot and wildfire.

Job 6. Selecting Site for Seed-Bed; Sterilizing Plant-Bed

Conditions Usually Found.—(1) Poor judgment in selecting sites for tobacco plant-beds is noticeable even among experienced growers. (2) Methods of treating the site for the plant-bed vary in different regions.

Aims.—(1) Beginners should learn the importance of a suitable site for the plant-bed and how to select it. (2) They should learn the importance and methods of treating the plant-bed.

Problems for Study and Discussion.—(1) Inquire of growers or visit their places and find what kinds of sites are used for tobacco beds.

2. What exposures do they consider best?
3. Should the ground be level or sloping?
4. Under what conditions is a windbreak desirable?
5. Should the bed be placed up and down the slope or on a level around the slope?
6. Describe an ideal site, giving reasons.
7. How do farmers treat the bed-site before it is sterilized?
8. Learn of growers the time of year to start the bed.
9. Describe different methods of sterilizing plant-beds, (a) steaming, (b) burning.
10. What bad effects result from failure to sterilize plant-beds?
11. What conditions govern the amount of burning for beds?
12. Compare the costs of burning and steaming plant-beds.

Activities.—Select one or more good sites for a plant-bed, fulfilling as many requirements as possible. Assist in sterilizing a plant-bed by different methods.

Choosing Site for Plant-Bed.—Tobacco plants are started in seed-beds several months in advance of transplanting. The site for the bed should

be a well-drained plot of land rich in organic matter. Virgin soil is often selected because it is loose, fertile and free from weed seed. Sod land, free from weeds, makes a splendid site and is easily prepared. Many successful growers select old fence rows because they are fertile, and this is an economical use of land. Any type of soil may be used for a bed by supplying organic matter and necessary plant food, yet the results will not be as satisfactory as those obtained on virgin soil or sod land. A sloping bed with southern exposure produces strong plants quickly. Some farmers prefer to place the bed up and down the slope, while others like the bed located around it.

When new land cannot be obtained for a bed the site selected should be well manured the preceding fall, plowed shallow, and sown in a cover crop. A plot treated in this way should produce an abundance of vigorous plants. Fall plowing is advisable for heavy sod land, which will thus have time to pack well and will retain moisture.

When the grower is prepared to steam the bed he can have a permanent plot conveniently located and use it indefinitely if he is careful to keep it fertile. Unless steam sterilization is practised it is best to change the bed each year. This avoids the danger of plant diseases.

Size.—To avoid a shortage in plants ample space should be allowed for the bed. About 100 square feet of seed-bed will plant an acre of tobacco. The beds are usually from 6 to 12 feet wide and as long as needed.

Sterilizing the Beds.—Young tobacco plants are so small and delicate that they require a properly prepared seed-bed to insure strong growth. Sterilizing the beds before planting time will destroy weed seed and help to avoid fungous diseases. Except when virgin soil is used the bed should be plowed before it is sterilized. This should be done as early in the spring as possible.

Burning beds is the most general method of sterilization. This consists in placing piles of wood and brush over the area and burning them. In burning, the best results are obtained by placing poles as skids on the bed, and then piling brush and heavier wood on the poles. The use of some green wood will keep the fire longer, thus sterilizing the soil to a greater depth.

Steaming Beds.—Since the cost of wood is increasing, the steaming method is employed in many places. It is practised extensively in western Kentucky. The equipment necessary for steaming consists of a boiler, a shallow sheet-iron or wooden pan, an iron pipe or a steam hose. A steam boiler made for a 20 to 25 horse-power engine will furnish sufficient steam for a pan with a surface area of 75 to 100 square feet. The size of the pan must correspond to the size of the boiler, so that the steam pressure of at least 75 pounds may be maintained. After the bed has been prepared the

pan is inverted over a part of the surface and the steam applied. The steaming requires from 20 to 30 minutes. After the pan is removed the steamed area is covered with old carpets, sacks, or tarpaulin, to retain the heat in the soil.

Plant-Bed Burner.—Some people use a plant-bed burner. This consists of a heavy sheet-iron pan, 6 to 10 inches deep, supported by an iron frame about 2 or 3 feet high. The sides and one end of the frame are covered with sheet iron and a stove pipe is placed in the closed end of the frame. The burner is placed on the bed, and soil from each side, to the depth of 3 or 4 inches, is shoveled into the pan. The fire under the burner sterilizes the soil in and under the pan. This method is tedious but saves fuel. Recently crude oil has been used for burning beds, but it cannot be recommended until it is more thoroughly tested.

FIG. 207.—Many farmers locate their tobacco beds along one side of the field where the tobacco is to be grown.

Job 7. Preparing Seed-Bed; Sowing Seed

Conditions Usually Found.—(1) Not all seed-beds are well prepared. (2) The successful tobacco grower gives special attention to proper amount of seed, even distribution and covering.

Aims.—(1) Growers should learn to prepare the seed-bed thoroughly. (2) They should learn the proper amount of seed to sow per unit of bed space, best methods for equally distributing the seed, and the depth and methods for covering seed.

Problems for Study and Discussion.—(1) Describe the best frames for plant-beds.

2. Calculate the cost of framing a plant-bed.
3. How soon after burning should the bed be sown?
4. Describe the steps in pulverizing the soil.
5. How much seed is required?
6. How is the seed sown?
7. Describe the various methods for covering the seed.

Activities.—Prepare soil, frame and cover for a plant-bed. Practise sowing seed.

Framing the Bed.—Permanent beds are usually framed more satisfactorily than temporary beds (Fig. 207).

Frames are for several purposes: (a) to protect plants from wind, cold,

and frost; (b) to aid in fastening covers, such as cloth; (c) to prevent insects and weed seed from gaining entrance.

Logs or poles are sometimes placed along the upper and lower sides and boards or logs are used across the ends. Wooden pegs are often driven on each side of the framing to hold it in place. Heavy plank frames are sometimes constructed to form substantial frames. The north side should be a foot higher than the south side to allow the cover to slope toward the sun.

Dirt is ridged against the framing on the outside.

If commercial fertilizers are to be used on the bed, they should be applied after it is sterilized. Even if the soil is thought to be very fertile, it is well to use some commercial fertilizer. Its use often makes plants earlier and stronger. The fertilizer is spread on evenly and raked into the soil well.

As soon as the bed has cooled it should be prepared for seed. It should be leveled and the surface thoroughly pulverized. If the soil is very loose it should be rolled. Most of the preparation should be given before sterilizing. If the bed is stirred deeply, weed seeds will be brought to the surface.

A teaspoon of seed to every 200 square feet of bed is sufficient. Seed sown thicker than this will crowd and produce dwarfed plants. 100 square feet of good bed will plant one acre of tobacco. Tobacco seed are so small that they should be mixed with something to give bulk before sowing. Sand, wood ashes, fertilizer or air-slaked lime can be used for this purpose. The seed may be scattered by hand or with the grass seeder. It is a good plan to go over the bed twice to get a uniform distribution.

Care should be taken to cover seed lightly. Some growers tramp the bed after sowing, while others use rollers or lightly rake in the seed. Rolling or tramping are better methods. If soil is too wet avoid packing. Young tobacco plants like a firm soil.

Job 8. Covering Plant-Beds. Caring for Beds

Conditions Usually Found.—(1) Mistakes are often made by not covering the beds well and at the proper time. Sometimes the covering is left on too long. (2) Beds often fail because of insufficient available plant food, too little moisture and lack of weeding.

Aims.—(1) Students should know the importance of covering beds carefully and at the proper time. (2) Students should know the importance and learn methods of weeding, watering bed, controlling insects and using fertilizers when necessary.

Problems for Study and Discussion.—(1) How soon after sowing should the bed be covered?

2. Why is it necessary that the soil be ridged against the frame on the outside?
3. Why should plant-beds be covered?
4. What materials are generally used for covering?

5. Describe the steps necessary in properly covering a bed.
6. How often should a bed be examined with reference to weeding, watering, fertilizing, ventilating and for insects and diseases?
7. Learn of farmers whether beds are ever re-sown.
8. Describe how plant-beds are weeded.
9. What fertilizers are commonly used, and how are they applied?
10. Study insects and diseases common to plant-beds and learn how to control them.
11. How long before transplanting should the cover be removed?
12. Learn how to care for bed after the first transplanting to insure more plants for resetting.

Activities.—Get samples of cloth used for covering beds with price of each. Make covers by the frame method and by the roller method. Practice glazing sash for beds. Test several thermometers to see that they read alike at different temperatures. Bring in plants from beds which show good and bad care of beds.

Covering Beds.—The production of good-quality tobacco depends to a great extent upon strong, vigorous plants ready to transplant at the proper season. The pioneer growers found it easy enough to grow good plants by merely covering their beds with brush, but conditions have changed so that the matter of covering (canvassing) is an important factor. Light cotton cloth known as tobacco cotton is spread over the bed as soon as possible after sowing the seed. Small nails are used to fasten the cloth to the framing. The purpose of the covering is to protect the delicate plants from cold weather and insects. If the bed is wide a strand of smooth wire drawn through the center will hold the cover off the growing plants. Glass is sometimes used to cover tobacco beds in northern regions.

Weeding.—Successful tobacco raisers give much time and attention to the care of the growing plants in the bed. They make it a practice to inspect the bed once and sometimes twice per week. It may be necessary to weed it if the burning or sterilizing were ineffective. A good practice for weeding is to remove the covering and put down a long board that can be supported on each side of the bed by the framing. With the body resting on the board one can remove the weeds without much damage to the plants.

Forcing Plant Growth.—In case the plants are tardy in their growth an application of liquid manure is advisable. Solid manure can be used effectively provided it is free from grass or weed seed. Nitrate of soda gives good results if applied to slowly growing plants. It is advisable to apply this in solution. Six pounds of nitrate of soda dissolved in fifty gallons of water will properly fertilize five square rods of bed. Clean water should be sprinkled thoroughly over the bed immediately after the nitrate solution to prevent burning the plants.

Cutworms and flea beetles are the most troublesome insects that infest tobacco beds. They can best be destroyed by spraying the bed with

Bordeaux mixture and arsenate of lead. Bordeaux-arsenate can be obtained in prepared form and with the addition of water is ready for use.

Job 9. Preparing the Field for Planting; Fertilizing the Plants

Conditions Usually Found.—(1) Best judgment is not always exercised in selecting time and manner for fitting the soil for planting. (2) The success of crops is sometimes hindered by improper spacing of rows and of plants in the rows. (3) Different fertilizers are used and they are applied in various ways.

Aims.—(1) Young farmers should learn the correct methods and time to put the soil in proper tilth. (2) They should learn that different soil conditions call for different distributions of the plants. (3) They should learn what fertilizers to use and the various ways to apply them.

Problems for Study and Discussion.—(1) What is the effect if land is plowed too wet?

2. Discuss the depth to plow for tobacco.
3. How should fall-turned sod be prepared for planting?
4. Discuss the preparation of soils that have cover crops.
5. How does late turning of cover crops affect the moisture supply for the growing plants?
6. Discuss the preparation of new-ground soil.
7. Learn principles that should govern the distribution of plants with respect to soil conditions.
8. Discuss plant distribution with respect to the different varieties of tobacco.
9. How does distribution of the growing plants affect the size and quality of the matured plants?
10. Learn of successful tobacco growers the proper amounts of fertilizers to use and the best time and methods for applying them.
11. Make a list of farm implements used in preparing a field for planting tobacco.

Activities.—Calculate the cost per acre of each harrowing of ground by timing yourself or other operators. Compare the amount of weeds on a plot harrowed several times with that on a plot not so prepared.

Preparing Soil.—Tobacco, like other intensively grown crops, requires a thoroughly prepared soil for the young plants (Fig. 208). The plowed soil is disked every week or ten days in the early spring to keep the land from baking or getting hard. This treatment also destroys weeds and conserves moisture. Just a few days before the plants are large enough to transplant, the land is crossbroken or disked, and harrowed or dragged until the surface soil is smooth and well pulverized. Rows are marked off three to three and one-half feet apart. The interval depends on the fertility of the soil and on variety of tobacco grown. If fine-quality tobacco with light color is desired the rows are marked not more than three feet apart; on the other hand, if heavy, coarse tobacco is preferred the rows are made three and one-half or four feet apart. Some growers check the rows, others set the plants 18 to 24 inches apart in drilled rows. The distances depend upon the type of tobacco grown.

Fertilizing the Plants.—It is a common practice to apply commercial fertilizer to the soil during the preparation for transplanting. The application is made in various ways. It is customary in some locations to

drill the fertilizers in before the rows are marked; in others it is drilled along the rows; and in others it is sown by hand in the marks of the checked rows. It is not uncommon to see several methods used in the same locality. The amount and kind of fertilizer that can be used profitably depends upon the productivity of the soil. Before fertilizers can be used intelligently the soil conditions must be well understood. For example, in certain sections of central Kentucky only nitrogen is deficient. In this particular region 200 pounds per acre of nitrate of soda or other nitrogen carrier gives profitable increase in yields. In practically all other parts of Kentucky phosphorus is also needed. Two hundred to three hundred

Fig. 208.—Plowing up a blue-grass field, with tractor-drawn plows, to plant the more remunerative tobacco crop.

pounds of superphosphate or basic slag usually give profitable returns. On lands that are in a low state of productivity a complete fertilizer is the most profitable. Five hundred to one thousand pounds per acre of 4–8–3 or 5–10–4 (N–P–K) will, under normal conditions, give good returns. Tests have proved that the use of fertilizer on the average farm is an economic practice. Increased yields and leaves of higher quality result from the use of the right fertilizing materials. It must be understood, however, that if the fertilizer is out of proportion serious injury may result. Too much phosphoric acid discolors the ash in cigar tobacco, and an excess of nitrogen gives coarse, thick leaves unsuited for cigar wrappers. Potash in chlorine compounds lowers the burning qualities of cigar tobacco. Sulfate of potash, superphosphate, and cottonseed meal can be used without injuring the plant.

Some farmers choose to apply the fertilizer after the plants have started to grow in the field. They believe that by judging from the growing plants, the kind and amount to use can better be determined. (See table in Appendix.)

Job 10. Transplanting

Conditions Usually Found.—(1) Sufficient care is not always exercised in drawing the plants from the beds. (2) Frequently the young plants die after transplanting when the work of setting is done carelessly, or when the moisture in the soil is deficient.

Aims.—(1) Managers should learn the best methods for removing the plants from the bed. (2) They should be taught to judge the proper moisture condition of the soil to insure the plants living and to exercise the necessary care in handling the plants through the various steps in transplanting.

Fig. 209.—Taking tobacco plants from the seed-bed where they were grown under canvas.

Problems for Study and Discussion.—(1) Why is it necessary to exercise care in removing the plants from the bed?

2. How are the plants transported from the bed to the tobacco field?
3. Learn how to transplant tobacco with the different machines.
4. Discuss the hand method of transplanting.
5. What advantages have the machines for transplanting?
6. What advantages has the hand method?
7. How large should the plants be when transplanted?
8. Give distances between plants and between rows in your region.

Activities.—Time operators, including yourself, in setting plants by different methods. Calculate the cost per acre by each method.

When to Transplant.—As soon as the plants are 5 to 7 inches high and the soil warm, the tobacco plants should be transplanted to the field.

This should not be done on hot or windy days. Immediately after a warm gentle rain is the best time for transplanting by hand.

Drawing Plants.—In removing plants to avoid trampling down the bed the workmen should stand on temporary benches made by extending boards crosswise over the bed (Fig. 209). Unless the plants are drawn after a good rain the beds should be well watered before removal of plants. They should be drawn one at a time so as not to injure the rootlets and to facilitate setting. The plants should be set the same day they are pulled. They should be laid in straight piles and carried in baskets to the field.

Fig. 210.—This tobacco-planting machine requires three men, but can set out many more plants in one day, and with less effort, than the three men could working in the old way.

Distancing the Plants.—Different varieties of tobacco and various types of soil require different distances between plants. Space between the plants in rows varies from 18 to 36 inches, and space between rows varies from three to four feet. If the soil is very fertile the plants may be set closer. Finer, brighter, smoother leaves result from close setting.

Planting with Machines.—In tobacco sections where the ground is fairly level machine planters are extensively used (Fig. 210). The machine opens one row and marks the line for the next. Three men are required to operate the planter, one to drive and two at the rear to place the plants. There is a tank on the machine which automatically waters the plants, and the soil is then pressed around them by two rollers or shoes. Three acres a day can be planted by this machine. With the machine

the crops can be set whenever the plants are ready, but when hand setting is practised the transplanting must wait on a season which comes as a result of sufficient rain to wet the ground thoroughly. Plants set by machine start growth more quickly than those set by hand.

Planting by Hand.—Many growers set their tobacco plants by hand because it takes workmen of less experience, is more economical, and on hill land is more practical. When set by hand the plants are distributed along the rows by one man, followed by two men who set the plants. This is done by making a hole with a peg, placing the plant in the hole and with thumb and finger pressing the soil to the plant. Either the hand or machine method of transplanting is effective if the plants are sturdy and properly handled.

Job 11. Cultivating the Crop

Conditions Usually Found.—(1) Weeds soon infest the tobacco crop unless intensive cultivation follows very soon after transplanting. (2) Even experienced growers do not always choose the best implements and the best method for cultivating the crop. (3) Failure properly to judge when and how deep to cultivate and when to stop cultivating is found among tobacco growers.

Aims.—(1) Operators need to know how to keep weeds from taking the crop. (2) They should learn what implements to use and the ways to use them most effectively. (3) When, how and how much to cultivate should be a part of every grower's information.

Problems for Study and Discussion.—(1) Make a list of all implements used in cultivating tobacco.

2. What governs the time and amount of cultivation the crop should have?
3. Make a drawing to show the root system of the tobacco plant.
4. How does the kind of root system affect cultivation?
5. How do growers know when to stop cultivating the crop?
6. Why are mules preferred to horses for cultivating tobacco?
7. How much moisture is required to grow one thousand pounds of tobacco?
8. How can moisture be conserved through cultivation?
9. Get opinions of farmers as to how cultivation affects the weight and quality of tobacco.
10. Name the weeds that cause most trouble in growing tobacco.
11. Learn the life histories of these weeds.
12. What are the common means used to kill weeds in tobacco fields?

Activities.—(1) Tabulate the names of growers and the dates and methods of cultivating tobacco in your region. (2) Make a trial to compare the results of two different types or plans of cultivation.

Intensive cultivation of tobacco is necessary for two purposes, to keep down weeds and conserve moisture (Fig. 211). It is well to begin cultivating the young plants as soon as they start to grow after transplanting. Shovel cultivators are commonly used for the earlier cultivation. Deep cultivating may be beneficial to young plants but quite injurious to them in the later stages of growth. The soil should be drawn to the plants rather than away from them. This can be done best with shovel cultivators. The mule is much better suited for plowing tobacco

than the horse on account of having small feet and quiet disposition. Hoeing the crop usually becomes necessary in order to break the crust and destroy weeds near the plants. The one-horse spring-tooth cultivators are the best implements for late cultivation because they stir the soil thoroughly without extending deep enough to injure the roots of the plants.

FIG. 211.—Cultivating his dark-tobacco project in Calloway County, Ky.

Cultivation is believed to hasten growth and should be continued every few days until the leaves practically cover the ground. No weeds should be allowed in the field.

Crab-grass, foxtail, pigweed, lamb's quarter, pursley and Jimson are some of the weeds that give most trouble to the tobacco grower.

Job 12. Controlling Enemies

Conditions Usually Found.—(1) The most expert farmers often have tobacco damaged by insects and diseases. (2) Some enemies are not well understood by a large number of growers. (3) Farmers do not always use the best methods for combating enemies.

Aims.—(1) The common enemies of tobacco and how they damage the crop should be known by tobacco growers. (2) They should make a thorough study of all insects and diseases that injure tobacco. (3) All methods for controlling enemies should be taught the students.

Problems for Study and Discussion.—(1) Make a list of all common insects that damage tobacco.

2. Make a list of all common diseases that injure tobacco.
3. In what other ways may tobacco become damaged?
4. Learn from your neighbors what pests are most destructive in your community.
5. Bring to the class plants to show the damage done by the various enemies.
6. Make special reports to the class on the following enemies: horn worm, bud worm, root-rot, wild-fire, grasshopper, cutworm, mosaic.
7. Discuss rotation of crops to control tobacco diseases.
8. Learn how to use Paris green to control insects.
9. How is arsenate of lead used to kill tobacco insects?
10. Bring the different kinds of dusters to class and learn how to use them.
11. How should a person dress to avoid danger to himself while dusting tobacco?
12. What enemies may injure cured tobacco in the bulk?

Activities.—Collect specimens showing the injury due to insects and diseases. Place some of these in a five per cent formalin solution in the laboratory. Collect and preserve horn worms and the adult hawk moths.

Fig. 212.—Young farmer in Hart County, Ky., dusting with poison against horn worms in Burley-tobacco project.

Controlling Horn Worms.—Tobacco plants are attacked by several kinds of insects, but the most common and harmful are the horn worms. The worms are larvæ hatched from the eggs of moths known to farmers as tobacco "flies." Soon after the tobacco plants have been transplanted the moths begin to deposit eggs upon them. The eggs, which are about the size of mustard seed, hatch in a few days and at once the larvæ begin to feed upon the leaves. The worms grow rapidly and at maturity one worm can eat half a medium-sized tobacco leaf in a day. In former days the farmer combated the horn worms by killing them by hand. This was a laborious task, but later the grower discovered that dusting Paris green

or arsenate of lead on the plants killed the larvæ. Paris green may be injurious to the leaves if applied in large amounts. Arsenate of lead and arsenate of lime are not so injurious to the tobacco leaves, and are recommended as better than Paris green. There are special dusters made for applying poisonous chemicals to tobacco. (Fig. 212.)

Small flea beetles often attack young plants, usually before they are set in the fields. They are easily combated by applying lead arsenate or calcium arsenate.

Wire worms, which attack the plants at their roots, are harmful enemies. As yet, no effective remedy has been discovered.

Cutworms.—Growers dread cutworms because they are hard to control. When these enemies infest the tobacco bed they may be eliminated by dusting the bed with arsenate of lead. When they appear in the

FIG. 213.—Grasshoppers destroy large amounts of tobacco each year. This machine, called a "hopper-doser," is a contrivance for their destruction. It is drawn about over the grass and stubble in which they hide.

field the growers reset the plants that have been destroyed, and, if possible, kill the worms. Sometimes grass, straw, or clover sprinkled with Paris green spread along the plant rows will help control cutworms.

Grasshoppers are enemies to the plant when it is nearly matured (Fig. 213). It is almost impossible to dust the plant at this stage of development, so arsenate of lead is applied to plants on the outside of the field. A poison bait scattered around the edge of the field is sometimes very effective.

Tobacco has disease enemies as well as insect invaders. Root-rot is a common disease that attacks tobacco in both beds and fields. Thorough sterilization of beds and change of bed sites should protect young plants from root-rot. Crop rotation helps to keep this disease from the field. There are certain strains of tobacco that have root-rot-resisting qualities.

Angular leaf-spot and wild-fire are bacterial diseases that spread readily. Often they destroy a whole crop. Both of these diseases start with a small dead spot on a leaf, which finally consumes the whole leaf and often all the leaves on the plant. These diseases are more prevalent in wet seasons. One way to combat wild-fire and leaf-spot is to treat the seed as described in Job 5. Care should be taken to select seed from a crop free of these diseases. The covers for plant beds should be sterilized.

Mosaic plague attacks many fields of tobacco. It is often considered a wet-weather enemy. It distorts the leaves and may destroy them. Mosaic is caused by a virus in the sap of the plant. It is easily spread and hard to kill, since it lives all winter in plant stalks, tobacco leaves and barns. As yet, no effective remedy has been discovered.

Job 13. Choosing Seed Plants; Topping; Suckering

Conditions Usually Found.—(1) Experienced growers realize the importance of topping and suckering at the correct stages of the plant's growth. (2) Mistakes are often made by improperly topping the plants. (3) Farmers do not always exercise good judgment in selecting seed plants.

Aims.—(1) Students should be taught that there are certain future developments in the plant that may be influenced by topping. (2) They should know when and how to sucker the plants. (3) Students should be familiar with the desired characteristics in tobacco before choosing seed plants.

Problems for Study and Discussion.—(1) At what stage of growth do the neighbors top tobacco?

2. What factors are to be considered before topping?
3. What kinds of plants should be saved for seed?
4. Find out how many plants to save for seed.
5. What benefits may come from careful selection of seed?
6. How should seed plants be protected after thay have been selected?
7. How should the seed be stored after harvest?
8. At what stages of growth should suckers be removed?
9. Why are suckers often left to become very large?
10. How do large suckers often damage tobacco?
11. Under what conditions will the plant require suckering more than once?
12. Describe the local methods and time of suckering.

Activities.—Choose enough seed plants for your needs, allowing for culling, cleaning, and testing. Practise topping and suckering plants.

Choosing seed plants is far more important than the average tobacco grower has yet realized. Through proper selection, treatment and care of the seed, the type, grade and price of the product can be improved materially. If good tobacco is to be grown, the first consideration is good seed of high germination test, free from disease, and of a variety best suited to the soil and climate where it is to be grown. Types and varieties of tobacco are susceptible to change through the influence of soil and climate.

Protecting Seed Plants.—If open pollination is permitted crossing of varieties may take place over a distance of a half mile or more. Certain

rules should be observed if seed selection is to be properly done. It requires time and patience to grow good seed but it will pay any tobacco grower to do it. Before going out to select the seed plants one should have in mind the type and variety of tobacco that he can and should grow for profit. If root-rot or any disease is in the community, disease-resistant plants should be selected for seed. Plants that are typical of the variety desired should be selected just before the blooms open, and the blooms immediately covered with a paper bag (Fig. 214). Self-pollination of the

FIG. 214.—Seed plants in a tobacco field covered with paper bags to prevent pollinization.

plants is the farmers' best practice to prevent change in type and varieties. The paper bag should be left on until the seed pods have set, then undesirable pods should be removed to give remaining pods advantage for full maturity. Suckers and small leaves about the top of the plant should be taken off (Figs. 215 and 216). Since one seed plant will furnish seed enough for several acres of tobacco, it is not a big task for any farmer to grow his own seed.

There are, however, experts who make it their business to grow tobacco seed. Buying seed from the expert is a growing practice.

Topping.—When tobacco is about half grown the flower buds appear. It is at this stage of the plant's growth that topping is done. The grower

walks between the rows and with thumb and finger breaks the tops out, usually taking two rows at a time (Fig. 217). The purpose of topping is to force the growth into the leaves and thus increase the size and weight of

FIG. 215.—This young man is suckering his dark-tobacco crop. He is a vocational agriculture student at the Lynn Grove, Ky., high school.

the marketable portion of the crop. Cigar tobaccos are usually topped high, i.e., from 16 to 20 leaves are left to grow, while low topping is the common practice with the growers of manufacturing types. If only 10 or

FIG. 216.—Suckering is one of the important parts of raising a crop of marketable tobacco.

15 leaves are left after topping the leaves will grow large, thick and heavy; if on the other hand more are left, the tendency will be toward a thin, light leaf of brighter color.

Suckering.—The plant in its effort to grow seed will produce suckers at the bases or axils of the leaves. These suckers must be removed, or the plant will produce an abundance of seed and very small delicate leaves of no particular value. Suckering is a long, laborious job, since most plants are suckered two or three times before they are harvested. Suckers are sometimes permitted to grow until they are quite large in order to improve the color and texture of the leaf. Where heavy tobacco is grown suckering is done closely.

Fig. 217.—Field hands topping tobacco.

Job 14. Priming

Conditions Usually Found.—(1) Only in particular regions and with certain types of tobacco is priming generally done. (2) Priming is a general practice over large areas when tobacco is selling for a good price.

Aims.—(1) Students should be taught how to judge whether or not priming is a paying practice. (2) They should know whether priming is generally practised with certain types of tobacco.

Problems for Study and Discussion.—(1) What tobacco is usually primed?
2. Explain how priming is done.
3. Locate on the map the regions where priming tobacco is a general practice.
4. When does it pay to prime tobacco?
5. If local growers have ever primed have them tell you their experience.
6. What grade of tobacco is saved by priming?

Activities.—Priming should be practised and the leaves saved by different methods.

For Dark Tobacco.—In the dark-tobacco districts of Kentucky and Tennessee, it was formerly a common practice, and one that is found yet to some extent, to pull off and discard two or three of the bottom leaves. This is known as "priming."

For Other Types.—Priming, the first step in harvesting, is not a general practice among tobacco growers. It is practised chiefly with the cigar-wrapper types and portions of the flue-cured crop. It is sometimes called "pulling." It consists in the removal of the most mature leaves at the base of the plant.

Methods.—No more than four or five leaves are generally pulled, but sometimes the entire plant is harvested this way. Priming enables the grower to harvest his crop gradually. It also improves the quality because all the plant strength is given to the growing leaves. The gathered leaves are strung on wires or tied in small bunches called hands. These are hung on racks and hauled to the barn. The hauling may be done immediately after harvesting, or the leaves may be left in the field for a short time, to wilt. Priming is an economic step in harvesting because it saves all the leaves and improves the quality. Labor and other conditions, however, make it impractical except with a few types.

Priming is practised some in Florida and the New England States and in the southern part of the flue-cured district.

Job 15. Preparing the House and Equipment for Housing

Conditions Usually Found.—(1) Many farmers neglect preparing the barn or building additional room until the rush of harvesting is at hand. (2) Farmers find it economical to prepare harvesting equipment at odd times or on wet days.

Aims.—(1) Students and growers should learn to prepare the barn and harvesting equipment when they are not busy in the crop. (2) Their attention should be called to the various kinds of equipment to be provided. (3) They should learn to make preparation on an economic basis.

Problems for Study and Discussion.—(1) When is a barn ready for the harvested crop?

2. Learn from your neighbors how much barn room to provide for each acre of tobacco.
3. How should the curing-house be ventilated?
4. How does crowded housing injure tobacco?
5. Report to class the various methods used in ventilating tobacco barns.
6. Draw plans and estimate cost for a modern tobacco barn for your particular community.
7. Discuss the proper location for a tobacco-curing barn.
8. Calculate the number of laths (sticks) required to hang an acre of tobacco.
9. Explain how farmers secure sticks in your community.
10. Draw on the blackboard all the kinds of tobacco knives you know about.
11. How do farmers prepare the wagon or sled frame for hauling tobacco?
12. Build a tobacco hauling frame in the farm shop.
13. Build a tobacco sled in the farm shop.
14. Explain what is meant by field-scaffolding tobacco.
15. Learn how to make a field scaffold.

16. Why do farmers sometimes field-scaffold their tobacco?

Activities.—Assist in cleaning and disinfecting a tobacco house. Make laths, repair racks, repair roofs, doors, and ventilators.

Types of Barns.—Tobacco barns should be located out in the open where the air circulation is good (Fig. 218). It is a mistake to locate the barns in or near a wood lot or place them in the bottoms or lowlands. Tobacco, especially at the curing period, requires a drying atmosphere. Curing houses that are built for air-curing have small doors that open along the sides, also roof ventilators. Those built for open-fire curing are tight with the exception of ventilators at the roofs and bottoms. The flue-curing barns are quite small and have the same ventilators as the open-fire curing barns. (See Job 1 for size of barn.)

FIG. 218.—A common type of tobacco barn, with stripping room. Notice the open ventilators on the side.

Equipping.—The framework in the barn is arranged so that the tobacco can be hung in tiers. The sticks should be hung from 6 to 10 inches apart in the tiers for air-curing and from 8 to 12 inches for flue-curing. Some farmers buy the sawed laths, others saw the logs and rive their own laths. In making preparation for harvest, the grower should see that the barn is cleared of farming implements and stored feed, and that the ventilators are swinging on their hinges; that the tiers are all in place, and that there is a sufficient number of laths on hand to hang the growing crop. It is well to examine the frames or sled for hauling tobacco to see if they need repair. If outdoor scaffolds are to be used they should be built previous to the harvest season. A common practice for the farmer is to go to the woods and cut poles for tiers and forked sticks to support

the tiers, haul them to the tobacco field, and with this equipment arrange the outdoor scaffold. In most regions tobacco is hauled on big frames.

Job 16. Harvesting and Scaffolding

Conditions Usually Found.—(1) Not all farmers can properly judge when tobacco is ready to harvest. (2) Various methods are used in harvesting tobacco. (3) Field-scaffolding is practised by some farmers.

Aims.—(1) Agricultural classes should learn how to judge when conditions are proper for harvesting tobacco. (2) All the best methods for harvesting the different types of tobacco should be known. (3) Classes should know the advantages and disadvantages of field-scaffolding.

Problems for Study and Discussion.—(1) Learn from successful tobacco growers when tobacco should be harvested.

2. What is meant by ripe tobacco?
3. Describe the different methods used in cutting and hanging tobacco on the laths.
4. What precautions are necessary in handling tobacco when it is cut?
5. When is it advisable to scaffold tobacco in the field and how long should it remain on the scaffold?
6. What other methods of wilting tobacco are used locally?
7. What hazards are often encountered in harvesting?
8. What factors govern the spacing of the laths on the scaffold?
9. How may improper housing cause the tobacco to house-burn?

Activities.—Cut tobacco by different methods. Practise all the harvesting and wilting operations. Wilting by different methods should be tested and compared.

Judging Maturity.—In about three months after tobacco is planted it is ready for harvest. Most tobacco in America is harvested by cutting the whole plant. After the plant has been topped three or four weeks certain noticeable changes occur. The leaves increase in size, weight and thickness. The color of the plant changes too, according to variety, but always there is a yellowing, either slight or pronounced. As the color changes the leaves become brittle. A common test for the ripeness of tobacco is by judging the texture of the leaves, brittleness of veins, and the change in color.

The character of the finished tobacco leaf depends to a large extent on its condition when harvested. If the plant is thoroughly ripened before harvest a thick, heavy leaf is the result. When it is harvested rather green a smooth leaf with much elasticity is the outcome. When tobacco is cut green the yield is much smaller than when it is harvested thoroughly ripe. Cutting green also increases the risks of injury after housing. In recent years tobacco cut rather green has brought higher prices, and some growers sacrifice quantity for quality.

Harvesting.—In harvesting the whole plant the general practice is to split the stalk from near the top to within a few inches of the ground. The stalk is then cut off near the ground (Fig. 219). In some regions the stalks are placed on sticks immediately after cutting, while in other sections

the plant is allowed to wilt before it is placed on the lath. (Figs. 220 and 221.) In spearing a metal spear-head is placed on the end of the stick and the plant is slipped over this onto the lath. If the spear is used the plants

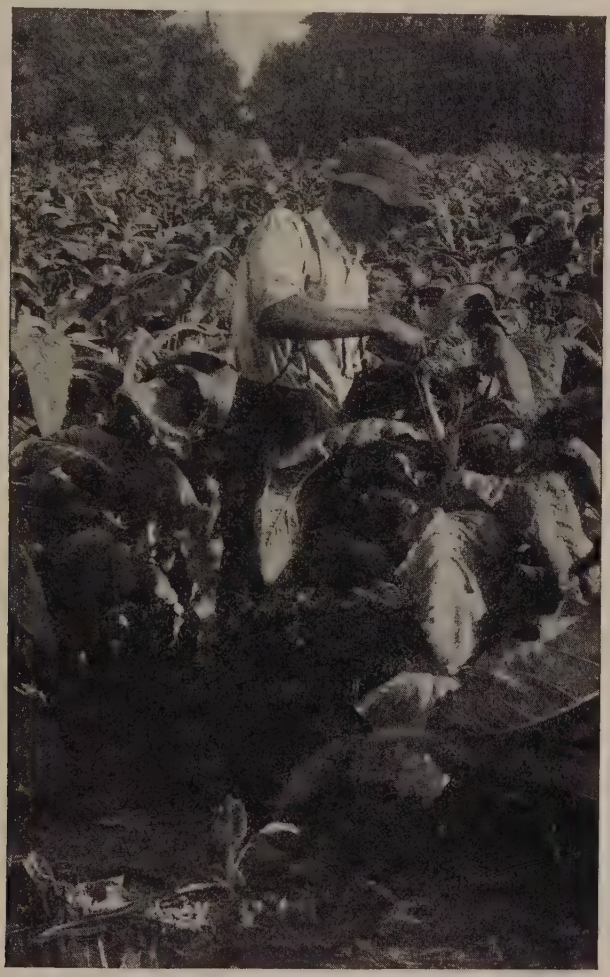

FIG. 219.—Cutting tobacco is one of the hardest tasks. The picture shows how it is done.

are not split at all. This is a rapid way of harvesting, but it increases the chances for bad curing. Tobacco laths are between four and five feet long, and will support from four to seven plants.

FIG. 220.—Vocational agriculture student harvesting his project crop of Burley tobacco. Hart County, Ky. The wilting stage.

FIG. 221.—When tobacco is cut the stalks are slit and slipped over a stick. These are left upright in the field to cure for a time. Later these sticks are hung in the curing barns so that the leaves hang down.

Preventing Sunburn.—It is important that the harvested plants be handled with care. If bruised, sunburnt, or allowed to burn in bulk, leaves will not properly cure. When the plants are cut in extremely hot weather they must be rushed to the curing house as soon as they become wilted enough to haul without breaking the leaves.

Wilting.—If the barn space is limited, or if the barn is a great distance from the field, it is advisable to hang the laths of tobacco on a temporary

Fig. 222.—Showing how tobacco is hung on scaffolds in the field before it is taken into barns.

field scaffold (Fig. 222). They should hang here until the tobacco is wilted and has acquired a yellow color. This process takes from 3 to 8 days according to weather and plant conditions.

Housing.—After tobacco has been placed on laths they are either loaded on a rack made for hauling tobacco or bulked on a sled, and taken to the curing barn. The tobacco supported on sticks is then hung on tiers one above another. In air-curing barns the laths are placed from 6 to 10 inches apart. In flue-curing the distance should be from 8 to 12 inches. When the plants are cured by open fire the spacings should be 4 to 8 inches.

Job 17. Curing Tobacco

Conditions Usually Found.—(1) More farmers fail in properly curing tobacco than in any other job unless it is in marketing. (2) In some sections fire-curing is a general practice. (3) Some tobacco requires a flue-curing process. (4) Air-curing is used in some sections.

Aims.—Students should understand the art of curing tobacco under different circumstances.

Problems for Study and Discussion.—(1) Learn from successful growers how to manage an air-curing program.

2. Describe open-fire curing.
3. Describe flue-curing.
4. How long is required to complete the curing process by each method?
5. What conditions indicate that tobacco is properly curing?

FIG. 223.—Type of tobacco curing house used in Connecticut Valley. Note the long, narrow ventilators. No fire is used in curing.

6. What methods of curing are best suited to the various types of tobacco?
7. Why is it difficult to become expert at curing tobacco?

Activities.—Assist in housing tobacco. Time the operations and calculate the cost of housing tobacco. Assist in curing tobacco by different local methods.

The object in curing tobacco is to take the moisture from the leaves in such a way as to leave as uniform a texture and coloring as possible. Much depends upon the way the tobacco is hung or arranged on the tiers in the curing house. The plants should be well spaced on the laths with not more than five large plants on each stick. The laths should be spaced properly on the tiers. If the green leaves stick together or if the plants are crowded in the tiers during the curing process, much damage may result from house-burn.

The air-curing method (Fig. 223) is very simple, yet it must be understood if best results are to be obtained. The main consideration is

to use the ventilators on the barn to regulate the curing process. The ventilators should be left open until the plants begin to yellow, then closed during the day and opened at night. The leaf must undergo certain chemical changes that give the desired qualities. Slow curing gives time for the chemical changes and thus improves the quality of the tobacco. Air-curing should be slower than artificial methods. After the leaves are thoroughly yellow the ventilators should be thrown wide open to hasten the curing as much as possible. If the weather is hot and damp the ventilators should be closed at night and opened during the day. If the weather is dry and warm there is but little danger of house-burn. Warm, wet weather greatly retards curing. It often becomes necessary in long periods of rainy weather to build fires under the tobacco and drive the moisture from the plants, otherwise rotting may result.

Open-Fire curing is done by first starting fires under the tobacco after it has been allowed to yellow for about one week. For the first few days the firing is light; it is gradually increased from day to day until the temperature is between 130 and 140 degrees F. The firing is usually continued until the leaves are thoroughly dry. This may require as much as ten days. Open-fire curing is used chiefly for dark tobaccos.

Flue-Curing.—Intense heat is created by a furnace at one side of the barn. Pipes lead across the barn and back again to a chimney. These heat the barn to suit the temperature for curing at different stages. The building is kept closed during the heating process. The ventilator is opened to remove moisture.

Flue-curing is done by raising the temperature to 90 or 100 degrees F. for the first 26 to 40 hours, then again raising it gradually to 130 and finally to 180. When this method is followed, curing may be completed in 72 to 96 hours.

Job 18. Stripping, Grading, and Bulking

Conditions Usually Found.—(1) Stripping is usually done on wet days during the winter season. (2) Poorly graded tobacco never brings the best price. (3) Tobacco well bulked always shows up to good advantage.

Aims.—(1) Students should learn to plan for stripping on wet days. (2) They should have much training and practice in the art of sorting and grading. (3) They should understand how to bulk and the importance of bulking properly.

Problems for Study and Discussion.—(1) What is meant by tobacco being "in case"?

2. What provisions are made by local farmers for stripping room?
3. Explain the stripping process as it is done in your community.
4. How can tobacco be kept in case for stripping?
5. What is meant by grading?
6. How many grades are usually made at the time of stripping?
7. What is meant by grading the hands of tobacco?
8. Discuss with successful growers the importance of grading.

9. Under what conditions is it safe to bulk tobacco?
10. How long will tobacco keep properly in bulk?
11. How is tobacco carried through the sweat?
12. Explain what is meant by redrying tobacco?
13. How is tobacco packaged and made ready for market by the farmer?

Activities.—Practice stripping tobacco until you become expert in this. Grade the leaves as they are stripped with much care. Bulking should be practised so the conditions of injury may be learned.

FIG. 224.—"Stripping" consists of pulling the leaves off the stalks.

Choosing the "Season."—After tobacco is thoroughly cured it is ready to prepare for market. This includes three steps: stripping, grading and bulking. Since tobacco will crumble if handled when dry, the grower must wait for a period of damp, warm weather before he begins stripping. This kind of weather is known among growers as a "season," at which time the leaves become soft and pliable so they can be easily handled (Fig. 224).

First Bulking.—When a "season" has come and tobacco has softened sufficiently, the loaded laths are removed from the tiers and carefully piled in large stacks or bulks (Fig. 225). In this first bulking the tops of the

plants overlap leaving the ends of the stalks on the outside. The bulks are then covered, thus keeping the leaves pliable for several days, even if the weather should become dry. If the leaves are too damp when bulked they will become warm and turn a dark color. Only enough tobacco to furnish stripping for a few days should be bulked at one time, especially in warm weather.

Stripping is removing the leaves from the stalks and tying them into bundles called hands. Each hand contains from 6 to 20 leaves according to size, weight and variety of tobacco. One man can strip from 150 to 200 sticks of unstripped tobacco per day. Some growers rehang the stripped leaves on the stick and hang them in the barn to redry, while others sell

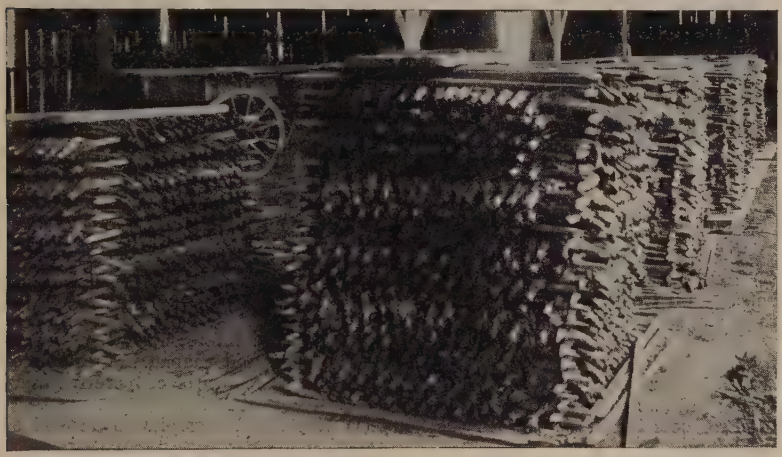

FIG. 225.—"Casing" tobacco, or "holding it in case," consists of piling it up when in order and holding it for future handling.

their tobacco immediately after they have stripped it, thus saving re-handling. This is usually governed by prices on the market.

Grading.—Each plant of tobacco produces several grades of leaves. They vary in size and weight from the bottom to the top of the stalk. Each type of leaf is used for a certain purpose, the leaves are therefore sorted into grades when stripped from the stalk. Some types of tobacco have more grades than others. The general divisions are trash, lug, leaf, and tip. These divisions are sometimes subdivided. No other factor helps more in increasing returns from the crop than careful grading. Generally speaking, the central leaves on a stalk bring the highest price, but grades vary materially in market value.

Final Bulking.—After tobacco has been stripped and graded some growers bulk it. If this final bulking is done in the winter, the leaves will

sweat about May. Unless they are again hung out to dry they may rot. After this final drying process the tobacco may be rebulked for an indefinite time (Fig. 226).

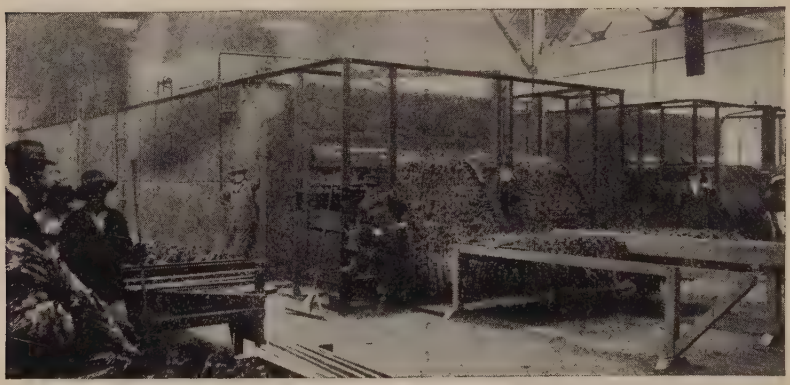

FIG. 226.—The gigantic redrying plant of the Growers' Association, Lexington, Ky.

Job 19. Marketing

Conditions Usually Found.—(1) Farmers market their crops in various ways. (2) Unsatisfactory prices are often received because of poor management in marketing. (3) Coöperative marketing has not been altogether successful but seems to be the best method of obtaining good prices.

Aims.—(1) Operators should understand fully the different ways by which tobacco may be marketed. (2) Improved methods and managerial principles should be learned. (3) Students should learn the principles of coöperative marketing and its benefits.

Problems for Study and Discussion.—(1) Explain the warehouse method of marketing.

2. Explain the loose-leaf method of marketing.
3. Point out advantages and disadvantages of the loose-leaf method.

FIG. 227.—Loose-leaf auction floor. This tremendous amount was offered for sale in one day. The rush to market and the confusion of heavy sales were held responsible for low prices and caused growers to organize the Burley Association.

4. Give reports on the history of coöperative marketing of tobacco.
5. Make a list of advantages and a list of disadvantages of coöperative marketing of tobacco.
6. Why do farmers fail to join and stay with a marketing association?
7. Can you describe some other ways by which tobacco is marketed?

Activities.—Visit selling floors and learn the details of handling and selling. Practice judging tobacco in "case" and out of "case." Judge the grades found. Students may practise buying and selling to each other or to their parents. Secure by-laws and contracts of tobacco-marketing associations and get members or managers to explain them.

Marketing Systems.—There are four general systems of marketing tobacco: (a) The practice of selling to buyers at the barn, (b) the warehouse method, (c) the loose-leaf system, and (d) the coöperative-marketing plan.

Selling at the Barn.—Before more modern systems were instituted, buyers, either independent or representing a company, would visit the barns, inspect the tobacco, and then bargain with the farmer for his crop. If the grower accepted the terms of the buyer, he delivered the crop and then received his return. This custom is almost obsolete.

The Warehouse Method.—Another means of marketing in former days was the warehouse method. Through this plan the grower packed or "prized" his tobacco in hogsheads and shipped it to warehouses in the larger cities. Here the tobacco was sold at auction, after the quality had been judged from samples taken from the hogsheads. This method of marketing is still practised somewhat. Auction houses are maintained at Louisville, Kentucky; Baltimore, Maryland; and a few other places.

The loose-leaf system of selling is the most prevalent custom now. Large, well-lighted, loose-leaf warehouses are maintained in both large and small cities in most tobacco sections (Fig. 227). After the grower has delivered his crop to the warehouse (Fig. 228), it is placed in flat baskets according to grades. The baskets will hold from 500 to 1000 pounds.

Fig. 228.—Loads of tobacco waiting to be unloaded at the loose-leaf market. Farmers often have to wait for several days because of the rush.

After the tobacco is weighed, the baskets are tagged and placed on the floor in straight rows with passageways between. Then, at appointed times, each basket of tobacco is sold separately at auction. The commission charges on selling are small. Immediately after the sale the grower

receives his check. In a few regions the tobacco is sold at auction from the wagon, which has been driven into a warehouse shed.

Coöperative Selling.—At different periods in tobacco history growers have formed associations through which crops are sold coöperatively. Perhaps the most effective association of this type ever formed among tobacco growers is the Burley Tobacco Growers Coöperative Association. (Fig. 229). This organization was founded in 1922 and modeled after the California Fruit Growers Association. The tobacco of the members is brought to a warehouse, is graded and weighed. Then the producer is given a receipt stating his holdings. He receives an advance of about forty per cent of the estimated value of his crop. When the tobacco is sold by the Association the producer receives additional payment. The Association owns all its warehouses and equipment (Fig. 221), and can borrow money on its tobacco and houses. Its future success depends upon the coöperation of its members. There is no doubt that coöperative market-

Fig. 229.—The Burley Tobacco Growers Coöperative Association stores its crop until the market is ready for it.

ing of tobacco or any other farm product is the best selling system for the farmer. It is important that the growers work to make marketing associations successful.

Job 20. Keeping Records

(See corn enterprise.)

RICE ENTERPRISE

By Jordan G. Lee, Jr., B.S.

Professor of Agricultural Education, Louisiana State University

Analysis into Jobs.—The following jobs are the main operations and teaching units in the rice enterprise. References are made to U. S. Farmers' Bulletins 1092, 1240; U. S. D. A. Bul. 1356; La. Bul. 172. See also *Rice* by Copeland.

1. Selecting land for rice. Farmers' Bulletin 1420.
2. Preparing the seed bed.
3. Planting rice.
4. Fertilizing rice.
5. Irrigating rice. Farmers' Bulletin 673.
6. Planning rotation of crops.
7. Controlling weeds and enemies. Farmers' Bulletins 1086, 1212.
8. Harvesting and marketing rice.

Job 1. Selecting Land for Rice

Conditions Usually Found.—Growers in rice sections usually understand the suitability of fields for rice.

Aims.—(1) Beginners need to study the special requirements for this crop. (2) They should learn the principal sections of the country adapted to the growing of rice.

Problems for Study and Discussion.—(1) What are the chief requirements for the successful growing of rice?

2. What States and countries meet the requirements for growing rice? (Fig. 230.)
3. Why should soils for the growing of rice have impervious subsoils?
4. Why are sandy soils not suitable for growing rice?
5. Why are sections that have a maximum rainfall best adapted to the growing of rice?

Activities.—On a map of the country shade the areas suited to this crop (Fig. 231).

The soil on which rice may be grown successfully is limited. This crop requires irrigation for its most economical growth and production; only that land which is level and has a bountiful supply of fresh water accessible to it is adapted to the growing of rice. The coastal plains of Louisiana and Texas are favorably endowed for the successful production of rice. Also, certain sections of Arkansas that border the rivers have developed into rice-growing districts. The soil, for the most economical production, should hold moisture, but should be easily drained and underlaid by an impervious subsoil.

Job 2. Preparing the Seed-Bed

Conditions Usually Found.—(1) Some farmers practise fall breaking, while others do not. (2) The seed bed is often not properly prepared, which results in poor stands and low yields.

Aims.—(1) Growers should learn proper methods of preparing the seed bed. (2) They should know why the seed bed should be properly prepared.

Problems for Study and Discussion.—(1) When should the soil be plowed? Why?

2. How deep should the soil be plowed? Why?
3. What preparation should the soil have in the spring just prior to planting? Why?
4. Outline a plan of procedure in preparing soil for rice.

Activities.—Assist in the preparation of soil for rice.

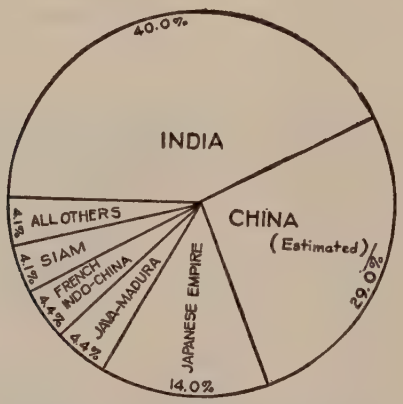

Fig. 230.—World's production of rice. Percentages by countries. 1922–1926 inclusive.

Fall Plowing.—The land should be broken in the fall during October and November while the pressure of other farm work is not too great. The cost is much less at this time; the work can be done more thoroughly; the soil is more thoroughly aërated; organic matter turned under has a much longer time in which to decay; and a good foundation is furnished for final spring preparation and seeding. Land broken in the fall should be well drained, otherwise trouble will be experienced in the final spring preparation.

Plowing Deep.—Experiments at the Louisiana experiment station show that it is best to break the land to a depth of from 5 to 7 inches. This results in better aëration, provides a greater feeding area for the rice plants, prevents loss of moisture during dry periods immediately following seeding, destroys weeds, gives a better germination, promotes a stronger

root growth, gives a better stand and a greater yield than shallow plowing.

Fining the Surface.—Experiments also show that the seed should be sown on a smooth bed rather than on a rough surface. Fall plowing should therefore be followed by spring harrowing, disking and dragging just prior to sowing the seed. This promotes a better stand, an even depth of planting, better germination and a greater yield per acre.

Farmers familiar with the preparation of soil for wheat or other small grain crops have little difficulty in preparing a good seed bed for rice.

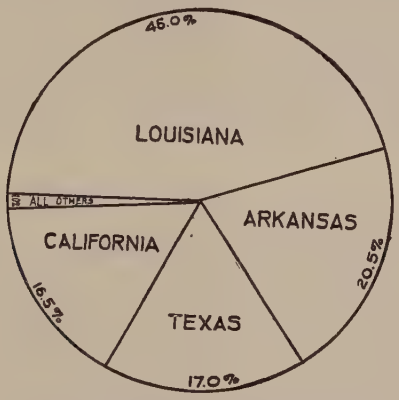

Fig. 231.—Production of rice in the United States. Percentages by states. 1922–1926 inclusive. (Chamberlain's Geography.)

Job 3. Planting Rice

Conditions Usually Found.—(1) Some farmers plant just as early as possible in the spring. (2) Some plant as late as possible. (3) Some plant on advice from the station authorities. (4) Growers seldom make serious mistakes regarding the depth and rate of planting.

Aims.—(1) Growers must determine the best time to plant and the depth and rate of planting.

Problems for Study and Discussion.—(1) When is the best time to plant rice? Why?

2. What is the best depth to plant rice? Why?
3. How much seed should be used per acre? Why?
4. What factors would influence the amount of seed to use per acre?
5. Compare drilling and broadcasting methods of seeding.
6. Outline a plan to be followed in planting rice.

Activities.—Broadcast seed on one plot and drill seed on another. Compare the results in cost, amount of seed required, and yields.

The best seeding date is approximately the middle of May. The rainfall is usually light during the first two or three weeks of May and this

admits of thorough preparation of the seed bed and destruction of young weeds. Experiments at the Louisiana station clearly show that planting should not be done, if the best yield is to be obtained, before the last week in April. When rice is planted earlier, or later than the middle of May, unfavorable weather conditions are usually encountered in the rice belt, and an unsatisfactory stand may result, with poor yields per acre.

Depth of Planting.—Rice should be planted from one to two inches in depth. When it is planted at these depths a heavy rain immediately following will not pack the soil sufficiently to interfere with the sprouting of the young plants. Should the weather turn off very dry immediately following planting or sprouting, irrigation water can be turned on and a good stand secured.

Rate of Seeding.—Experiments conducted at the Louisiana station over a six-year period show that the greatest yield is obtained when seed is drilled at the rate of 80 pounds per acre on a well prepared seed-bed. One hundred pounds of seed per acre gave practically the same results. The drill method gave a slightly larger yield per acre than broadcasting the seed by hand. If the date of seeding is earlier than May, more seed should be sown per acre, because less of it will germinate.

Job 4. Fertilizing Rice

Conditions Usually Found.—(1) Very little attention has been given, by the average rice farmer, to maintaining or improving soil fertility. (2) Crop rotation to improve or maintain soil fertility has not been practised to any great extent.

Aims.—(1) Students and growers should learn to determine the best fertilizers for rice. (2) They should be able to maintain and improve soil fertility.

Problems for Study and Discussion.—(1) In what form does rice obtain its nitrogen supply?

2. Why is it that nitrate of soda has not given satisfactory results when applied to rice?
3. Study the different methods of fertilizing rice and write out your conclusion as to the best method.
4. Write out a plan for fertilizing which you consider practical for the rice belt.

Activities.—Visit fields of rice fertilized differently, examine the rice carefully and make comparisons.

Because of the fact that rice secures its nitrogen supply in the ammonia form, commercial forms of nitrogen have not given entirely satisfactory results. Nor have commercial forms of potassium and phosphorus been entirely satisfactory. Results obtained at the Louisiana station show that when rice is rotated with soybeans and the soybeans are turned under there is a marked increase in yield of rice following. "An average yield of 2353 pounds of rice per acre was secured when the crop was grown in rotation with soybeans. This yield is 1213 pounds greater than the average yield obtained by the use of superphosphate alone. It also is 711 pounds greater than the average yield from the combination of sulfate of ammonia and

sulfate of potash, which gave the highest yield of any commercial fertilizers that were applied." * (Figs. 232 and 233).

FIG. 232.—Showing fertilizer tests on experimental rice plots, at Crowley, La.

FIG. 233.—A field of rice showing a good stand in a good rotation.

Job 5. Irrigating Rice

Conditions Usually Found.—(1) Growers generally practise good methods in flooding rice.

Aims.—The student should determine (1) when to flood and (2) how deep to flood the field.

Problems for Study and Discussion.—(1) How long should it be from the time of emergence (sprouting) until flooding should begin? Why?

2. What factors influence the length of time after germination when flooding should begin?

* U. S. D. A. Bulletin 1356, page 18.

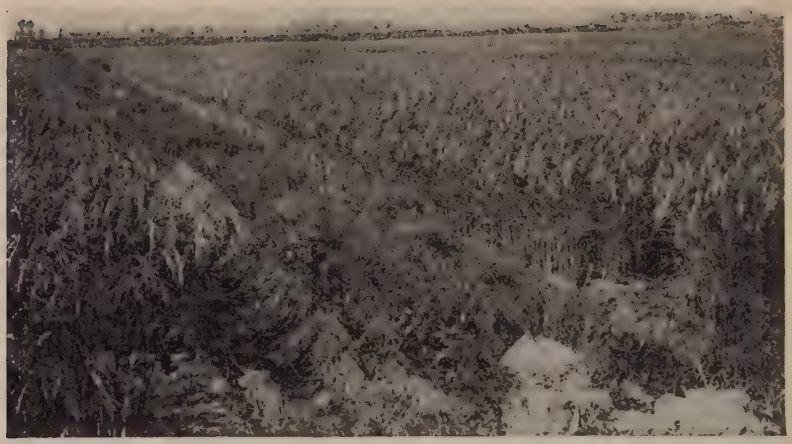

FIG. 234.—Rice field, showing irrigation ditch. Ditches are put at intervals through the field, as are also levees.

FIG. 235.—The character of a levee is clearly shown in this rice field. It will hold the water when the field is flooded for irrigation.

3. How deep should the rice be submerged?
4. What factors control or influence the depth of submergence?
5. Write out a plan which you think practical to follow in the rice belt.

Activities.—Assist in diking and ditching a field for irrigating and draining it.

Experiments show that the best yields of rice are obtained, everything else being equal, when flooding is begun fifteen days after germination. (Figs. 234, 235 and 236). Where rice is grown in rotation with soybeans, submergence can be delayed for thirty days with no apparent loss in yield.

On very level land, submergence to a depth of from 4 to 6 inches and even 2 inches is sometimes sufficient. About 6 to 8 inches usually gives the best results.

Fig. 236.—Repairing levees on his rice project. (Gueydon, La., Voc. Ag. Dept.)
Fig. 237.—These students are keeping a close watch on their rice crop so as to harvest it at exactly the right time.

Job 6. Planning Rotation of Crops

Conditions Usually Found.—(1) Most farmers allow their land to rest for a year or two—grow up in weeds and grass on which cattle and horses are grazed. (2) Some farmers pasture cattle and horses on the "resting" land. (3) Some farmers practise a rotation system using several crops.

Aims.—Students should learn the advantages and disadvantages of each practice and decide which to follow.

Problems for Study and Discussion.—(1) Compare the yields of rice from land where continuous cropping of rice has been practised with yields from land which has been rested and pastured with cattle.

2. Make the same comparison with yields from land where a rotation system has been practised. Tabulate the results and draw your conclusions.
3. Find as many rotation systems as possible and compare the several systems, especially where a variety of crops is used.
4. What variety of soybeans has been found to be most desirable to use in a rotation with rice? Why?
5. Give the advantages of soybeans in a rotation.
6. Plan a rotation which you consider is well adapted to the rice belt.

The practice of crop rotation has not been common in the rice belt of Louisiana and Texas. It has been the general practice among rice farmers

to rest their land for a year or two after growing several crops of rice. This land is usually allowed to grow weeds and grass on which cattle and horses are pastured. The practice is still very common. This practice has been followed, however, only when weeds and especially red rice have gained such headway that the yield and grade of rice was seriously affected. This practice has not materially reduced weed and red-rice infestation and it has not materially increased the fertility of the soil.

Other and better methods of controlling weeds and improving the fertility of the soil have therefore come into practice with some farmers.

Experiments clearly show that the soybean is the best crop to use in a rotation system with rice. Soybeans planted in four-foot rows and cultivated as frequently as necessary will practically control the weed situation and at the same time materially increase the yields of succeeding crops of rice.

Corn has been tried in the rotation scheme, but is not as desirable as soybeans. In the cultivation of corn in the rice belt it is necessary to plant it on a ridge and cultivate it on a ridge. This buries the red rice seed to such a depth that they lie dormant until the succeeding crop of rice is planted, when they are brought to the surface and immediately germinate. Cultivation of corn does not continue late enough in the season to prevent weeds growing and producing a heavy crop of seed before frost. Corn does not add to the fertility of the soil. The Biloxi variety of soybeans has given the best results.

Job 7. Controlling Weeds and Enemies

Conditions Usually Found.—(1) The weed problem is one of the primary problems with which the rice farmer has to deal. (2) Almost every field is more or less infested. (3) Red rice, imported in seed rice, is the chief weed with which the farmer has to deal. (4) No systematic plan of eradication has yet been adopted.

Aims.—Students and growers should understand the damages, life history and best methods of control of the different weeds and enemies.

Problems for Study and Discussion.—(1) Give methods of weed control.

2. Give the advantages and disadvantages of each method.
3. What crop or crops are best to use in a rotation system for weed control?
4. What advantages have soybeans over other crops?
5. What methods of weed control do the farmers of your locality practise in controlling weeds?
6. Compare the effectiveness of each method and draw your conclusions.
7. Outline a practical method of weed control for your community.

Controlling Weeds.—There are four methods of weed control in producing rice: (1) cultural; (2) crop rotation; (3) irrigation; (4) resting and grazing the field.

The cultural method consists, primarily, of turning the soil in the fall, and giving it light cultivations at intervals, using harrows and disks, until the seed are sown. This method is fairly effective in that a great

many young weeds are destroyed between the first of March and the middle of May.

The rotation method, when the proper crop is used, is probably the best to use. This method not only destroys the weeds but increases the fertility of the soil at the same time. Soybeans have been discussed in this connection in previous pages (Job 6).

The irrigation or flooding method controls the weeds only during the time when the water is on the rice, and has the disadvantage of not controlling the growth and development of wild red rice. Red rice in fact thrives under irrigation.

Resting and grazing the land has little effect on the control of weeds. If the land is pastured closely enough, red rice may be reduced to some extent, but this method has not proven satisfactory in weed control.

Other Enemies of Rice.—Smut attacks rice and may be prevented by the hot-water treatment or the formaldehyde treatment. Rice blast is a disease which causes the stems to break at the nodes. As the trouble occurs near the surface of the water, growers sometimes deepen the flood as they see the disease appear. If the attack comes late the water is drained away instead.

Insects are kept in fair control if flooding is properly managed. Alternate flooding and draining of fields is very effective against weeds and insects.

Job 8. Harvesting and Marketing Rice

Conditions Usually Found.—(1) Many farmers "dump" their crop on the market at harvest time. (2) This causes a heavy decline in prices. (3) Farmers have been very slow in taking advantage of the coöperative commodity-marketing association.

Aims.—(1) Growers and students should understand the present methods of marketing rice. (2) They should understand coöperative commodity-marketing associations. (3) The systems should be compared and the best chosen.

Problems for Study and Discussion.—(1) Describe maturity of rice.

2. Describe the harvesting and threshing of rice.
3. How does Louisiana compare with Texas and Arkansas in rice production?
4. The bulk of the rice crop in this country is grown in three southern states. How should this affect market problems?
5. Why would it be easy to form a commodity-marketing association which would automatically control the bulk of the rice crop in this country?
6. Describe the operations of such an association.
7. Do you favor a tariff on rice? Why?
8. Make a study of different methods of marketing rice and plan a method which you think would succeed.

Activities.—Graph prices of rice for several years. Compare with this the production for each year.

Harvesting.—Rice is cut when in the stiff dough stage (Fig. 237). Grain binders and threshers are usually used (Figs. 238 and 239). If

damp when threshed the grain is spread out to dry on floors or other dry places. The grain may then be stored for a time in sacks or in bins.

Marketing Problems.—Louisiana, Texas and Arkansas produce the bulk of the rice grown in this country. It should therefore be a very simple matter to bring the rice growers of the three states together to form one big marketing association. As simple as it seems, however, the chances are it will never be done. There are influences and combinations at work which tend to block any organization of farmers which has for its purpose the marketing of the rice crop.

Coöperative Marketing.—In a single commodity of this kind a large fraction of the growers may agree to sell their crop through a market-

Fig. 238.—Student shocking rice. This picture shows how flat the rice fields are. Gueydon, La., Voc. Ag. Dept.

Fig. 239.—This vocational agriculture student is examining the shocks of rice to see if the crop is ready to thresh. Gueydon, La., Voc. Ag. Dept.

ing association. Each grower is paid a part of the market price as soon as any part is sold by the association. Payment to all is made from time to time as sales progress. The gradual unloading of the crop upon the market through the association helps to maintain the prices, not only for members but for others. The costs of the association are usually much less than the benefits received through advanced prices.

Plans for storage through the Federal warehouse system guarantee fair grading, honest weighing, low cost of storage and insurance. Money can often be borrowed on the unsold portion of the crop at federal rates.

SUGAR-CANE ENTERPRISE

By Jordan G. Lee, Jr.

Professor of Agricultural Education, Louisiana State University

Analysis into Jobs.—The following teaching units or jobs include the main operations in the sugar-cane enterprise. References are made to U. S. Farmers' Bulletin 1034 and U. S. Dept. Bul. 829.

1. Selecting the soil and field.
2. Planning a rotation for sugar cane.
3. Selecting the variety.
4. Fertilizing sugar cane; supplying organic matter.
5. Selecting seed cane.
6. Preparing soil for planting.
7. Planting the crop.
8. Cultivating.
9. Controlling diseases.
10. Controlling insects.
11. Harvesting and marketing sugar cane.

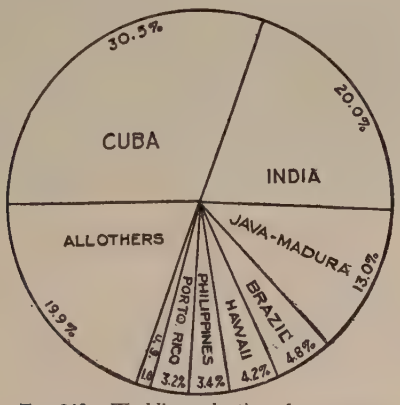

FIG. 240.—World's production of cane sugar. Percentages by countries. 1922–1926 inclusive. (Chamberlain's Geography.)

Job 1. Selecting the Soil and Field

Conditions Usually Found.—(1) Farmers do not always select the land best adapted to cane. (2) Farmers do not, as a rule, provide adequate drainage for their cane land.

Aims.—Growers should understand the soil requirements for sugar cane.

Problems for Study and Discussion.—(1) What kind of soil is best suited for cane? Why?

2. Why does sugar cane require a large amount of water for its best development?
3. Why is a poorly drained soil not best for cane?
4. Locate land on your farm which you consider good sugar-cane soil and give reasons for your selection.

Activities.—Collect samples of different types of soil found in your region. Mark on each the degree of suitability for sugar cane.

Sugar cane, for its best growth and development, requires a well-drained soil but one which retains its moisture. A soil which contains a large percentage of clay and silt, with an abundant supply of humus, seems to be better adapted to the commercial production of sugar cane than one that is very sandy in nature (Fig. 241). However, cane does not do well on heavy "buck-shot" soils. These soils are usually poorly drained and are conducive to the development of root-rot

Fig. 241.—In an experimental plot, such as is conducted at a state station, proper soil for different varieties may be determined. This saves growers much time, and perhaps great loss as well.

A clay-loam or silt-loam soil, rich in humus, provides, during a season of normal rainfall, a sufficient amount of moisture and plant-food materials for the best development of the cane plant. The cane plant requires an abundant supply of moisture for its maximum development; it does not, however, do well in a soil saturated with water and poorly drained. (Fig. 242.)

Job 2. Planning a Rotation for Sugar Cane

Conditions Usually Found.—(1) Growers do not give enough attention to maintaining the fertility of their sugar-cane soils. (2) The rotation practices of the majority of farmers do not add to or maintain the fertility of the soil.

Aims.—Students should learn the rotation systems usually practised and their advantages and disadvantages, and should determine which is the best.

Problems for Study and Discussion.—(1) Outline the rotation system usually practised in the sugar belt.

2. What are the advantages and disadvantages of the common system of rotation?
3. What rotation system is recommended for the sugar belt? Give its advantages.
4. What legume is recommended for this improved rotation, and why?

5. Work out a system of rotation which you consider practical for your conditions.

Activities.—Make a chart or table with the names of several growers. Indicate the crop preceding sugar cane in each case.

The Common Rotation.—The usual rotation system in the sugar belt is corn and a legume one year followed by two years of cane. Cowpeas have been the favorite legume, though some farmers have used soybeans. This practice has not kept up the fertility of the soil, which has been losing in fertility from year to year. The first reason for this condition is that the legume is usually harvested for hay, and only the roots, corn stalks, grass and weeds are left on the land to be turned under. This practice does not add nearly enough nitrogen and organic matter to the soil to take care of the tremendous requirements of two crops of cane.

Fig. 242.—Drainage ditch in a sugar-cane field.

A Better Rotation.—A system of rotation which is giving excellent results at the present time is two years of corn and soybeans, or soybeans alone, followed by two years of cane. Under this system, it is recommended that the corn be harvested and the corn-stalks and soybeans be turned under. Where soybeans are planted alone, the seed may be harvested and the vines turned under.

When soybeans are used in the rotation and turned under, a larger amount of organic matter is added to the soil, soybeans giving practically twice as much tonnage per acre as cowpeas or other legumes. Not only is a larger amount of nitrogen added to the soil, but the additional organic matter improves drainage, increases the moisture-holding capacity, aërates the soil, acts on the insoluble salts and renders them soluble, and improves the bacterial action. The Biloxi variety of soybeans is recommended on account of its long, luxuriant growth.

Job 3. Selecting the Variety

Conditions Usually Found.—(1) Farmers in general have not given much attention to variety selection. (2) Farmers are beginning to realize that variety selection will help to improve the industry.

Aims.—(1) Students and growers should learn the leading standard varieties of cane. (2) The advantages and disadvantages of each variety should be understood. (3) The newer varieties of cane that show promise of future development should be considered.

Problems for Study and Discussion.—(1) Name the standard varieties of cane.
2. Which variety will do best under adverse growing conditions?
3. Compare the standard varieties and indicate your choice for your conditions.
4. Name the newer varieties of cane.
5. Why do experiment stations test new varieties?
6. Why should field selection of seed cane be practised?

Activities.—Collect samples of different varieties for laboratory study.

The standard varieties of cane that have given the best results are (1) Louisiana Purple, (2) Louisiana Striped, (3) D 74.

The Louisiana Purple has been grown for a very long time. It is found in practically every section of the states bordering on the gulf coast and is widely made use of in making syrup. It is also very popular in the sugar belt and has stood the test of time, as being one of the very best varieties grown.

This variety is purple in color, suckers freely, produces a good tonnage per acre, yields about 130 pounds of sugar per ton. It stands adverse conditions better than the other varieties.

The Louisiana Striped is a cane with purple stripes running lengthwise of the stalk, and has also been grown for a long time. It is fairly well distributed over the states bordering on the gulf coast, though not as extensively as the purple. This variety is practically as hardy as the purple and yields about as much sugar per ton. The tonnage per acre is about the same as that of the purple, and it stands adverse conditions about as well.

The D74 was imported into Louisiana by the Louisiana station in 1893. It is of a white-greenish color and produces a very large stalk. It is not as hardy as the purple; but, when grown under favorable conditions, on a very fertile soil, produces a larger tonnage per acre and more sugar per ton.

Other varieties under test at the present time which show some promise for the future sugar industry are (1) P. O. J. 213; (2) P. O. J. 36; (3) P. O. J. 228; (4) P. O. J. 826; (5) P. O. J. 234. These are all canes with a small barrel, or small stalk diameter. They have shown up well at the Louisiana station and hope is held out that some of them may develop into dependable commercial canes. Other P. O. J. varieties are (1) P. O. J. 2725; (2) P. O. J. 2727; (3) P. O. J. 979. These canes have a larger barrel than the first mentioned and show considerable promise.

Job 4. Fertilizing Sugar Cane; Supplying Organic Matter

Conditions Usually Found.—(1) Farmers have been practising a three-year rotation, one year of corn and a legume, followed by two years of cane. (2) It has been the practice to pull cowpea vines for hay instead of turning them under. (3) The cane lands have become very deficient in organic matter and humus. (4) When commercial fertilizers are used, the farmers show very poor judgment in their selection.

Aims.—(1) Students and growers need to realize the amount of plant-food material removed from the soil by a crop of cane, and to learn the best way to replace this material.

Problems for Study and Discussion.—(1) Why does cane require a large amount of plant-food material?

2. How much nitrogen, phosphorus, and potassium is removed from an acre of land by a crop of cane producing twenty tons per acre?
3. How much nitrate of soda will it take to replace the nitrogen removed?
4. How much superphosphate will it take to replace the phosphorus removed?
5. How much sulfate of potash will it take to replace the potassium removed?
6. At what time during the development of cane plants should commercial fertilizers be applied?
7. Give the advantages in using legumes to build up the soil.
8. Write out a plan that would be practical to follow in improving and maintaining soil fertility on a sugar farm.

Activities.—In a set of 3 bottles show (a) the nitrate of soda for one acre; (b) the superphosphate for one acre; (c) the sulfate of potash. Use one gram of each for every pound in the acre.

Sugar cane requires a large amount of plant food material for its best growth and development. Cane, producing about twenty tons per acre, removes from the soil approximately 68 pounds of nitrogen, 43 pounds of potassium, and 29 pounds of phosphorus. This is a very heavy drain and must be returned to the soil in some manner if average or maximum crops are to be harvested.

This plant-food material can be returned in two ways: (1) by plowing under legumes, and (2) by the application of commercial fertilizers.

Adding Organic Matter.—When a legume, such as cowpeas, soybeans, velvet beans, or clover, is turned under, nitrogen is added to the soil. When this organic matter decays, certain organic acids are given off which act on the insoluble salts in the soil and make them soluble. Humus is also formed, which helps to aërate the soil, improves the water-holding capacity and improves drainage and texture. Better results from commercial fertilizers are obtained when applied to soils that have an abundant amount of humus.

Potash.—Most soils in the sugar belt are rich in potassium and need only organic matter added to make it available. The sandy soils are not so rich in potassium as the clay soils, and an application of some potassium fertilizer is advisable on such soils.

The nitrogen compounds usually used are (1) nitrate of soda; (2) dried blood; (3) tankage; (4) sulfate of ammonia; (5) cottonseed meal

and (6) cyanamid. From 100 to 300 pounds of nitrate of soda per acre, depending on the soil, will usually furnish enough nitrogen. The other compounds can be applied in proportion.

Superphosphate is the phosphorus compound used to supply the phosphorus. From 100 to 300 pounds, depending on conditions, is usually applied. This material was formerly called acid phosphate.

FIG. 243.—The sugar cane on the right was from selected seed. That on the left was from unselected seed. The advantages of selection are perfectly plain.

Applying Fertilizers.—Commercial fertilizer should be applied in the spring about the time the cane is well up. It is usually applied as a side dressing. If nitrate of soda is applied at this time, the young cane is given a good start, and, everything else being normal, a good crop is produced.

Job 5. Selecting Seed Cane

Conditions Usually Found.—(1) Farmers seldom select their seed cane. (2) Diseases and other unfavorable conditions have lowered the yield of cane per acre and yield of sugar per ton of cane. (3) Seed selection gives promise of eliminating to some degree some of the limiting factors in cane production.

Aims.—(1) The advantages and methods of selecting seed cane should be understood.

Problems for Study and Discussion.—(1) What is meant by planting field-run cane?

2. Explain what is meant by selected cane.
3. State dangers of planting field-run cane.
4. State advantages of planting selected cane.
5. Outline a plan that can be followed in selecting seed cane on the average cane farm.

Activities.—Practise selecting seed cane. Compare good and bad samples in all local varieties.

Fig. 244.—Student selecting seed cane.

Need of Selecting Seed Cane.—Only in very recent years has any attention been given to the selection of seed cane. Farmers, in general, have been in the habit of planting field-run cane. In fact, in most instances, they have picked out the very poorest cane for planting. The prevalence of such diseases as root rot and mosaic curtails the yield of cane per acre to such an extent that seed selection is becoming one of the main factors in fighting these diseases (Fig. 243).

Method of Selecting Seed Cane.—Seed selection is merely the selection of those stools of cane that have six or eight large stalks that show resistance to or freedom from the diseases mentioned above (Fig. 244).

The Louisiana station has been selecting seed for a number of years. The results secured, up to the present time, are most encouraging. (Fig. 245.) Cane properly selected shows a decided increase in tonnage per acre. Seed selection is beginning to interest a number of farmers.

FIG. 245.—Showing satisfactory results of selecting seed cane.

Job 6. Preparing Soil for Planting

Conditions Usually Found.—(1) Poor land preparation is a common practice with the cane farmer. (2) Very few farmers practise fall preparation of the land. (3) Too many wait until late winter or early spring to prepare the land.

Aims.—(1) The best practices in preparing soil for planting cane and the adaptation of one method to the sugar farm should be learned.

Problems for Study and Discussion.—(1) When should the soil be plowed for sugar cane?

2. Give the usual rotation system practised in the sugar belt.
3. Why is it an unwise or unprofitable practice to harvest cowpea vines and soy-bean vines instead of plowing them under?
4. Why should the organic matter be turned under in the fall?
5. Should land on which cane is to be planted be broken in the fall or in the early spring? Why?
6. What is the purpose of ridging or bedding the soil?
7. When is the soil harrowed, if fall plowing is practised?
8. Outline a plan to be followed in preparation of cane land for planting.

Plowing for sugar cane should be done some time in advance of planting if the previous crop will permit.

The usual rotation system in the sugar belt is one year of corn and a legume, followed by two years of cane—one year of plant cane and one year of stubble. The corn is harvested in August and the legume, usually cowpea or soybean vines, is harvested for hay, though this is an unwise practice. The land is then plowed. A good turning plow or disk plow is used. All refuse left on the ground from the previous crop should be completely covered.

Bedding.—When best methods are followed, ridges or beds 5 or 6 feet wide are thrown up a few weeks later. This preparation is made during the last half of September and the first half of October. The ridges or beds are intended to aid in drainage. The soil is left in this condition until planting begins, at which time it is harrowed well and the beds are opened for planting.

Decaying Organic Matter.—When vegetable matter is turned under in the fall, it has a chance to decompose and to release a part of its plant-food materials by the time the young sugar-cane plants are able to use it in the spring. The soil is also aërated, which causes it to warm up quicker in the spring, thus insuring an early start in the development of the young plants.

The soybean is fast replacing cowpeas on sugar-cane farms, because of the luxuriant growth of such a variety as Biloxi.

Job 7. Planting the Crop

Conditions Usually Found.—(1) Too much cane is planted in the fall on poorly drained soil. (2) Not enough cane is planted in the fall on well-drained land.

Aims.—(1) Students and growers should learn how cane is propagated. (2) The best time to plant and the best methods of planting should be known.

Problems for Study and Discussion.—(1) How is sugar cane propagated in this country?

2. What is meant by: (a) node? (b) internode? (c) eye? (d) bud? (e) root buds?
3. What factors determine the time of planting?
4. When is the best time to plant? Explain.
5. When cane is planted in the spring how is seed cane carried through the winter?
6. Why is spring planting more desirable in the northern part of the sugar belt?
7. What factors determine the amount of seed cane to use per acre?
8. How much seed cane is usually used per acre?
9. Outline a plan for planting seed cane that is applicable to your conditions.

Activities.—Practise planting cane. Different rates and methods may be compared.

Eyes or Buds.—Sugar cane, like the Irish potato, is propagated vegetatively. Canes are planted instead of true seed. The cane stalk is made up of nodes (joints) and internodes. Each internode contains a bud or "eye." Buds alternate from one side of the stalk to the other. Each

bud is capable of developing into a plant. Around the node is a light ring containing white dots. These are root buds and develop into roots when the stalk is planted. The whole stalk is planted in this country.

The Time of Planting varies with the region and the condition of the soil. Along the gulf coast, planting can be done either in the fall or in the spring. Grinding begins about the 20th of October; therefore fall planting must be done prior to this time.

Spring planting begins in January and continues until completed, often as late as the middle of March. Cane for spring planting is cut before the first frost in the fall and placed in windrows. In the northern part of the sugar belt, planting is done in the spring to avoid danger of freezing. In this region, the canes are cut in the fall and placed in large, well-drained beds with a sufficient covering of earth to protect them from freezing.

Fall Planting.—It is best to plant in the fall provided the soil is well drained. Planting is less expensive at this time, and results show that under normal conditions, a better yield is so secured. Fall-planted cane shows less borer infestation.

Planting Methods.—Immediately preceding planting, the ridges are opened to a depth of about six inches. The whole cane stalks are laid along in these furrows. If the cane is diseased, or damaged in any way, the stalks are laid in double rows; in extreme cases cane is sometimes tripled in the furrow. After it is distributed the stalks are chopped into pieces. This permits them to lie closer together in the row and insures a more compact spacing after the cane is up. The cane is then covered —using a turning plow.

From three to six tons are usually planted per acre, depending on the condition of the cane and land. With the P. O. J. varieties less seed is required, one to three tons per acre being sufficient.

Jub 8. Cultivating

Conditions Usually Found.—(1) Farmers do not all practise the best methods of cultivating cane.

Aims.—(1) The best methods to follow in cultivating plant cane and stubble cane should be understood.

Problems for Study and Discussion.—(1) When should the cultivation of cane begin? Why?

2. Give the methods of cultivation best adapted to planting cane.
3. Give the methods of cultivation best adapted to stubble cane.
4. Why should a stubble digger be used on stubbles early in the spring?
5. Outline a plan of procedure in cultivating plant and stubble cane on your farm and give reasons for your decisions.

In early spring, after the danger of freezing weather is past, a scraper is run over the planted cane to remove the excess dirt. This allows the

young plants to emerge easily. The cane is then barred off with a turning plow. All the soil is removed from around the young cane except a narrow row. This allows the soil to warm up quickly around the young plants and a more rapid growth is the result.

When the plants begin to sucker freely, fertilizer is applied as a side dressing.

Later cultivation begins in the usual way, using cultivators and turning plows to bring the soil gradually back to the cane-row as it progresses in growth. Cultivation continues until the crop shades the soil.

FIG. 246.—Vocational student examining sugar cane for disease.

Stubble cane is first barred off. This leaves the stubble on a flat ridge about ten inches wide. The rotten top part of the stubble is then shaved off with a cane shaver to a depth of two or three inches. A stubble digger is then used to dig and loosen the soil around the stubble. This allows the soil to warm up quickly around the buds and the young plants soon appear. Cultivation then proceeds as in the case of plant cane. The crop is given frequent cultivations until it is large enough to shade the middles. It is then laid-by.

Job 9. Controlling Diseases

Conditions Usually Found.—(1) Cane diseases are limiting factors in the production of sugar. (2) Farmers do not often practise control measures recommended. (3) They seem to think that some way will be found to control diseases without participation on their part.

Aims.—The diseases of cane and the practical control methods should be learned.

Problems for Study and Discussion.—(1) Make a study of the farms in your neighborhood and identify all the diseases of cane you find (Fig. 246).
2. What control measures are being used by the farmers of your community?
3. To what extent are these control measures showing results?
4. How do the several diseases affect the cane plant?
5. Work out a plan of disease control for cane which you consider practical for your community.

The principal diseases which attack cane are (1) mosaic, (2) root rot, (3) red rot. They have seriously affected yields of sugar.

The mosaic disease is recognized by the peculiar striping of the leaves. The leaves are much lighter in color where the mosaic is present. This disease retards growth and results in decreased tonnage per acre.

The control methods are seed selection and selecting varieties that show resistance to the disease. Of the old varieties, the Louisiana Purple and the Striped show the greatest resistance. There are several strains of the P. O. J. variety which show resistance; these are mentioned under Varieties (Job 3).

Root rot attacks the roots of the cane plant, completely destroying that part of the system attacked and making it impossible for the plant to obtain its normal food supply. Cane badly infected with root rot, during a dry season, produces a very poor yield per acre. This is due to the fact that the root system has been rendered inactive to such an extent that those roots which are left can not begin to supply the moisture needs of the plant.

Control methods recommended by E. W. Edgerton, plant pathologist of the Louisiana Station, are (1) better drainage, (2) better fertilization, (3) better rotation system, (4) seed selection, (5) selection of resistant varieties. The varieties mentioned previously have shown up best in root-rot resistance.

Red rot disease in cane can be recognized by the peculiar red color it produces inside the stalks. The red area is streaked with lighter-colored stripes running transversely across the stalk. The disease does not show on the outside of the stalk. It materially reduces the sucrose or sugar content of the cane. It seems to be worst during very wet seasons.

The control methods are (1) seed selection, (2) control of the borer, as the disease ordinarily enters the stalks through the borer holes, (3) better drainage and cultural methods.

Job 10. Controlling Insects

Conditions Usually Found.—(1) Farmers have not, in general, adopted methods of insect control. (2) Many do not realize the tremendous losses which occur from the ravages of insects. (3) These seem to think that the methods of control recommended are not practical and are too expensive.

Aims.—(1) Growers and students should become acquainted with the insects which attack the cane plants. (2) They should learn control measures and work out practical methods of control.

Problems for Study and Discussion.—(1) Name the insects that attack cane plants.

2. Which of these are of most importance?
3. Give the control measures for each insect.
4. Tabulate the control measures practised by each farmer in your community.
5. Compare these measures with those recommended by your station.
6. Work out methods of control adapted to your conditions for each cane insect found in your community.

Activities.—Collect cane insects for study. Preserve these in bottles of formalin to keep at home.

The principal insects that attack the cane plant are (1) cane borers, (2) cane-stalk beetles, (3) mealy bugs, (4) grassworms, (5) aphids. The cane borer is by far the most important, with the cane-stalk beetle ranking second in importance.

Cane Borers.—L. L. Janes, agricultural statistician of Louisiana, and T. E. Holloway, in charge of United States sugar insect laboratory, have estimated the damage done by the borer at twenty per cent of the crop, as an average for a number of years. According to Louisiana bulletin 198 the loss in 1925 amounted to one-third of the total crop of the state.

The borers attack the cane plant in their larva stage. They bore through the central part of the stalks and emerge at maturity as buff-colored moths. The moths lay eggs on canes, corn, and rice plants or other grasses, and the life cycle is repeated. Cane infested with borers is hard and fibrous, has less juice and produces less sugar per ton. It also makes very poor seed. When used for seed, it gives a very poor germination and requires a larger amount of seed per acre. This results in poorer stands and lower yields for succeeding crops.

Control measures have not been entirely satisfactory. The Louisiana station recommends three methods of control as being practical for the sugar-cane farmer: (1) cultural, (2) insecticidal, (3) trap crop.

Cultural Control.—This method is simply putting into practice agricultural sanitation. It consists of plowing under early in the fall, immediately after the cane is harvested, all cane leaves, tops, and other refuse left on the ground; also, plowing under all corn stalks and other refuse where corn has been grown. All head lands should be plowed, in fact everything should be buried or burned which harbors the borers. Where the cane fields are burned off, all refuse left after burning should be immediately plowed under. This refuse should not be buried too deeply, but shallow enough to admit air so that decay will immediately begin.

Insecticidal Control.—Several insecticides have been tried in borer control with varying success. Arsenicals are ineffective. The material

which gives the most promise for the future is the sodium silico-fluoride dust. To reduce the burning effect of this material, it should be mixed with one-tenth of its weight of fresh hydrated lime. While the cane is young, the dust may be applied with any good dusting machine found on the market, but only airplanes can treat large cane, and this is a commercial operation. Sugar-cane borers produce five or six generations in Louisiana: probably one application of the insecticide each for the third, fourth, and possibly the fifth generations, at the rate of fifteen to twenty pounds per acre, is sufficient. Results obtained during the season of 1926 were very encouraging. On seven plantations a kill of between 60 and 70 per cent was obtained.

Trap Crop Control.—Moths of borers prefer to lay their eggs on good thrifty corn when it is available. When corn is present, the first two generations develop on it. The control of the first two generations in the spring and early summer is a distinct step forward in controlling future generations which come on in August and September. The August and September borers are the ones that do the major damage to sugar cane. In view of this fact, early plantings of corn may be made purposely, or used as they occur. This borer-infested corn can be harvested, fed green to livestock, and followed by a crop of soybeans on the same land. Or a succession of corn plantings may be made. Corn, as a trap crop, should be planted on good land, cultivated well and fertilized to secure a luxuriant thrifty growth, to be most attractive to the borers.

Cane-Stalk Beetles.—This insect attacks the basal portion of young plants and causes them to wilt and die. No satisfactory control measure is known. The following control measures are recommended to alleviate, to some extent, the ravages of this insect: (1) Trap lights may be scattered over the field at night. These are merely vessels containing water with a film of kerosene and with a light to attract insects. (2) Liming the soil may do some good. (3) Where a crop of corn or cane has been almost totally destroyed, soybeans should be sown thickly broadcast. (4) Keep corn, cane and sorghum off the land for a year or two. (5) Practise better drainage.

Mealy Bugs.—These insects suck the juice from cane stalks. The damage from these bugs does not amount to much if the Argentine ants are not also present. If the ants are present, try to control the ants by frequent cultivation. Treating seed cane with hot water will destroy the bugs.

Grass worms are sometimes troublesome. They may be destroyed by spraying with any good insecticide, especially arsenate of lead.

Aphids.—These insects, in themselves, do not cause serious damage to the cane plants. They aid, however, in spreading mosaic disease.

Job 11. Harvesting and Marketing Sugar Cane

Conditions Usually Found.—Farmers follow the accepted practices in harvesting.

Aims.—The best time and methods of harvesting should be learned.

Problems for Study and Discussion.—(1) What time of year does harvesting begin? Why?

2. Describe the usual method of harvesting.
3. Why do the mills object to an excess of green joints?
4. Give the differences in methods used when harvesting for milling and harvesting for seed. Why a difference?
5. Outline a method of harvesting you consider practical for your conditions.

Activities.—Assist in harvesting cane by different methods. Compare the methods as to costs.

FIG. 247.—Experimental sugar-cane mill, where the sugar content of different varieties is determined. It does not pay to grow cane that produces little sugar.

Harvesting begins about the 15th of October in the sugar belt. Practically all harvesting is done by hand. The leaves are stripped from the stalks. The stalks are then topped just above the last red joint and cut as close to the ground as possible. A cane knife is used in this operation. The stalks are put in piles across the rows, then loaded into carts and wagons by hand or with a cane loader, and hauled to the mill, or to freight cars for shipment to the mill (Fig. 247).

There is very little sucrose in the green joints of cane and therefore the mills insist that the cane be cut just above the last red joint.

Sales and Prices.—Mill owners take the sugar-cane crop at contract price or at an established market price for the season. Payments are made to each grower according to the sucrose content, as shown by tests.

Harvesting Cane for Seed.—In this work more care must be exercised in stripping so as not to injure the buds. Cane for seed is very rarely stripped of all leaves. When cane is planted in the fall, it is merely topped, cut, and stripped of a few leaves, and immediately planted. Seed

to be planted in the spring is cut and immediately placed in windrows with the leaves and tops intact. At planting time the leaves are stripped, the tops cut off, and the stalks planted.

References to State Bulletins and Circulars.—La. 185, 191, 197, 198, 199 Circ. 47, 92.

ASPARAGUS ENTERPRISE

By Edward W. Garris, B.S., M.A., Ph.D.

Professor of Agricultural Education, University of Florida

Analysis into Jobs.—The treatment given for asparagus will consider the production of this vegetable for the early spring market and not for canning. U. S. Farmers' Bulletin 829 is on Asparagus, other references are made to U. S. Farmers' Bulletins. See vegetable garden books by Lloyd, Corbitt, Thompson, and Bailey.

1. Determining possibilities with asparagus for market.
2. Choosing the variety to plant.
3. Selecting soil and field.
4. Growing cover crops and providing organic matter.
5. Obtaining good seed and testing seed.
6. Planting seed and producing crowns.
7. Buying and mixing fertilizers.
8. Preparing the field for the crowns.
9. Setting the crowns in the field.
10. Cultivating asparagus.
11. Controlling enemies.
12. Harvesting, grading and packing.
13. Marketing asparagus.
14. Keeping cost records. 511, 572, 782, 1182.

Job 1. Determining Possibilities with Asparagus for Market

Conditions Usually Found.—(1) Asparagus is grown for market only where soil and climatic conditions are favorable. (2) Well-established asparagus beds produce good crops for years. (3) The farmers who grow asparagus usually receive profitable returns for the crop.

Aims.—Students should understand the reasons why asparagus needs a certain kind of soil and climate, and the probable returns to be expected in growing this crop.

Problems for Study and Discussion.—(1) Find the acreage devoted to asparagus in your community.

2. What is the average cost per acre of growing asparagus in your community?
3. What yields do farmers in your community make?
4. Ask several farmers concerning prices which they receive for asparagus.
5. Could you secure the proper amount of capital needed in growing this crop? How would you secure it?
6. What difficulties have farmers had in marketing asparagus?
7. Find how long it takes to produce a crop of asparagus from crowns.
8. How can you carry this enterprise for the proper length of time?

Where Asparagus Is Grown Commercially.—Asparagus may be produced in the home garden in practically every section of the United

States. As a truck crop, however, the area is limited chiefly to sections of the following states: California, New Jersey, Illinois, Massachusetts, South Carolina, Pennsylvania, and New York.

Yields Per Acre.—Yields per acre vary from one year to another in the same community. With the proper fertilization a farmer can reasonably expect to produce from 100 to 150 crates per acre. In many cases much better yields are made. The ages of the crowns influence the yield as well as the productivity of the soil.

Cost Per Acre.—The cost per acre for growing asparagus is rather high as compared with some of the other truck crops. Asparagus is a rather heavy feeder and usually takes liberal amounts of fertilizers. All factors of cost vary, but an acre should not cost more than $200.00. The probable cost range is from $75.00 to $200.00 per acre.

Prices Usually Received.—The prices per crate for asparagus are high during the first of the season. Prices of several dollars per crate are sometimes received for the first shipments. Later a shipment may not bring the freight costs. Satisfactory average prices are usually received for the asparagus crop.

Duration of a Plantation.—The length of time an asparagus bed will produce profitable returns will depend upon the treatment it has received and the depth at which the crowns were planted. The deeper the crowns were planted the longer it may be expected that profitable yields will be produced. If the beds are not properly fertilized only spindling shoots are produced. In practice, farmers usually obtain profitable crops from 5 to 10 years from one planting.

Job 2. Choosing the Variety to Plant

Conditions Usually Found.—Farmers of a community usually plant one certain variety. Many communities select a certain variety because it is resistant to rust.

Aims.—The importance of certain varieties for resisting rust and of growing only one variety in the community should be understood by students.

Problems for Study and Discussion.—(1) What varieties of asparagus are grown in your community?

2. What varieties are resistant to rust?
3. What advantages are obtained in growing only one variety in a community?
4. What variety does the market like best?

Variety to Grow.—In most sections it is very important to select a variety which is resistant to rust. The Palmetto and Mary Washington are two such varieties usually recommended for planting in the South. Farmers should select one of the varieties and never try to plant any others on account of getting them mixed. The product can be standardized better for grading and packing if only one variety is used.

Job 3. Selecting Soil and Field

Conditions Usually Found.—The selection of soil is a problem to which most farmers give attention. The crowns are planted deep in loose soil.

Aims.—Growers should learn to be able to judge soils best suited for the production of asparagus.

Problems for Study and Discussion.—(1) What kind of soil in your community is used for producing asparagus?

2. Which type of soil in your community will produce the earliest shoots? Why?
3. What advantages do you see in selecting a deep soil?
4. How much do farmers consider weed and grass seed in selecting soil for an asparagus bed? Why is this important?
5. Of what importance is drainage in selecting soil for asparagus?

Kind of Soil for Asparagus.—This crop can be grown on a wide variety of soils. In some cases, especially in California, muck soils are used. In the South, sandy and sandy-loam soils are used in preference to all others. This type of soil can be easily plowed 10 or 12 inches deep for planting the crowns. A sandy or a sandy-loam soil is also important for the production of asparagus for the early market.

Care should be taken to select soil free from harmful weed or grass seeds because it is hard to separate the young plants from weeds. It is also important to select well-drained soil because the plants will not withstand long submergence in water.

Job 4. Growing Cover Crops and Providing Organic Matter

Conditions Usually Found.—The need of organic matter in soils is often not fully realized by growers. In some cases the tops of the asparagus give the only added organic matter.

Aims.—Beginners should learn the value of a proper amount of organic matter in the soil and should work out a plan to provide for this.

Problems for Study and Discussion.—(1) Find if any of the farmers in your community grow cover crops on asparagus beds.

2. How do farmers provide the necessary organic matter?
3. To what extent are the tops turned under in the fall? What are some of the disadvantages of this practice?
4. How many farmers in your community supply organic matter by the application of barnyard manure?

Value of Organic Matter.—Organic matter is very important in the production of asparagus and should be supplied in some manner. Many farmers supply this by putting barnyard manure on the asparagus beds at least every other year. Some summer intercrop may be grown between the beds of asparagus and turned under at the first cultivation in the late fall. Many farmers turn under the tops of the asparagus in the fall just after they have been cut. This may be a good practice except that diseases and insects are not destroyed.

Job 5. Obtaining Good Seed and Testing Seed

Conditions Usually Found.—Most farmers select seed from the field. Few growers ever test the seed before planting.

Aims.—The importance of selecting seed from well developed stalks which are free from disease should be learned by students.

Problems for Study and Discussion.—(1) Find whether farmers in your community save asparagus seed.

2. What is the difference between a staminate plant and a pistillate plant?
3. What advantage is obtained from selecting seed from stalks free from disease?
4. If you do not have seed for your asparagus bed, where would you secure them?
5. How much seed is needed to produce crowns for an acre?
6. How many seeds are produced in a berry?
7. What time is saved by planting crowns rather than seed?
8. Which crown is better, one from a staminate plant or from a pistillate plant?
9. How would you test seed for vitality?

Activities.—Practise testing seed. Examine seed with a lens for impurities.

Securing Good Seed.—Many farmers select seed from well-developed plants in the field. Care should be taken to select plants free from rust and ones which have well-developed berries. The berries are green in color at first and turn red as they mature. Each berry has three divisions.

If a person is just going into the business of growing asparagus, he may be able to secure seed from some reliable seedsman or from some neighbor farmer in his community.

One pound of seed should produce from 2000 to 3000 good crowns. It is well, however, to always allow plenty of seed, because it is slow in germination.

Testing Seeds.—The most practical way of testing asparagus seed is to use the rag-doll method, described under the treatment of melons.

Seed Treatment.—Station trials indicate that most garden seeds should be treated as indicated in the Appendix.

Job 6. Planting Seed and Producing Crowns

Conditions Usually Found.—Farmers usually plant seed and produce the crowns to set in the field. Healthy crowns are selected for planting in the field.

Aims.—The advantages of planting seed and producing crowns rather than having to buy the crowns should be learned by growers.

Problems for Study and Discussion.—(1) At what time of the year do farmers in your community plant asparagus seed?

2. How deep would you cover the seed?
3. What width of row do farmers use for the asparagus seed-beds?
4. What farmers in your community sow seed in the permanent bed? What advantages or disadvantages do you see in doing this?
5. Which crowns should be selected for planting a field?
6. What care should be given the young plants in order for them to produce good crowns?

Activities.—Practise sorting a lot of asparagus crowns into good and poor lots.

Planting Asparagus Seed.—The seed-bed should be well prepared before the seed is planted. It is desirable to select a rich soil and to use

liberal amounts of commercial fertilizers if good crowns are to be produced the first year. Most farmers prefer one-year-old roots to older ones for transplanting to permanent beds.

The seed is planted in the early spring just as soon as the land can be prepared. Rows are laid off about three feet apart and the seed covered approximately two inches. Sometimes the rows are placed 18 inches apart if hand cultivation is to be given. After the young plants come up they should be thinned to about four inches apart and given frequent though shallow cultivation.

During the late fall the male or staminate plants may be marked with tags and used for planting in the permanent bed. These crowns usually produce better yields, and they do not produce seed plants, which may give trouble as weeds. The staminate plants may be identified by their producing only pollen-bearing flowers, while the female or pistillate plants produce the seed.

In certain cases farmers have tried planting asparagus seed in permanent beds. This practice does not usually produce good results because the crowns are too near the surface of the soil.

Job 7. Buying and Mixing Fertilizers

Conditions Usually Found.—Few farmers home-mix commercial fertilizers. Fertilizer is usually purchased as high-grade ready-mixed material.

Aims.—Students should learn what special fertilizers are best for this crop. They should understand the advantages and methods of coöperative buying of fertilizers. They should understand how to home-mix fertilizers.

Problems for Study and Discussion.—(1) Ask local truck farmers what fertilizers are used for asparagus.

2. Find whether or not these fertilizers are bought coöperatively and mixed at home.
3. What reasons are given by farmers for buying ready-mixed goods?
4. When is asparagus given a side dressing? What fertilizers are used?
5. How much would it cost per ton in your community to home-mix fertilizers?
6. At what rates are the commercial fertilizers applied?
7. At what time of the year do farmers apply fertilizers?

Activities.—Practise mixing fertilizers for asparagus. Mix two lots in different proportions for comparison in growth.

Fertilizers for Asparagus.—Barnyard manure is a very desirable kind of organic fertilizer to use for asparagus. It is usually applied at the rate of 8 or 10 tons per acre.

Commercial fertilizers are also used. A complete fertilizer which will analyze about 8 per cent phosphoric acid, 5 per cent nitrogen and 5 per cent potash should produce good yields if applied at the rate of 1000 to 2000 pounds per acre. Farmers seldom apply less than one ton per acre.

All fertilizers usually give better results if applied in the spring rather than later in the summer.

Home-Mixing of Fertilizers.—Farmers can sometimes save several dollars per ton by purchasing the different materials and mixing them. In this way it is possible to make up any desirable formula. A farmer is certain then what kinds of fertilizer material make up the fertilizer. (See formula table in cotton enterprise.)

Job 8. Preparing the Field for the Crowns

Conditions Usually Found.—Farmers usually prepare the soil 8 to 10 inches deep. (2) The rows are laid off with a turning plow.

Aims.—The importance of preparing the land deep for planting asparagus crowns should be understood by asparagus growers.

Problems for Study and Discussion.—(1) How deep do farmers of your community prepare the soil for asparagus?

2. What kind of plow is used in preparing the land?
3. At what time of the year is the land prepared?
4. How are the rows laid off?

Preparing the Soil.—It is very important that the soil for planting asparagus crowns be prepared not less than 8 to 10 inches deep. Some farmers use a tractor in preparing the soil and others use a good turning plow. The land is usually prepared and the crowns put out in the early spring. In some cases the crowns may be set to the field in the late fall.

After the soil is prepared the rows are laid off by opening them with a turning plow, going not less than twice to each row. The rows are from 4 to 5 feet apart for green asparagus and 5 to 6 feet apart for blanched asparagus.

Job 9. Setting the Crowns in the Field

Conditions Usually Found.—(1) Farmers usually set the crowns in early spring. (2) The crowns are placed in furrows at least 8 to 10 inches deep.

Aims.—Students should understand the advantages of setting the crowns deep.

Problems for Study and Discussion.—(1) At what time of the year do farmers in your community set asparagus crowns?

2. Visit a field and determine the depth of the crowns.
3. How far apart would you put the crowns in the row?
4. What is the difference between green "grass" and blanched "grass"?

Activities.—Practise setting crowns properly. Compare different depths of setting crowns.

Setting the Crowns.—Most farmers prefer to use one-year-old roots from staminate plants. These roots should be carefully selected and all small roots discarded. The crowns are planted in the early spring although a few farmers plant in the late fall.

After the rows have been opened about 10 to 12 inches deep by running a turning plow at least twice in each row, the crowns are placed along the row from 15 to 20 inches apart. The crowns are covered with 2 to 3

inches of soil. The deep furrow is filled in gradually the next spring during the cultivation of the plants.

Job 10. Cultivating Asparagus

Conditions Usually Found.—Farmers usually give asparagus clean, shallow cultivation during the growing period.

Aims.—Managers should understand the value and methods of cultivation.

Problems for Study and Discussion.—(1) What farmers grow companion crops with asparagus during the first year? What crops are used?

2. How do farmers mound the soil for blanched asparagus?
3. What kinds of farm implements are used in your community for the cultivation of asparagus?
4. At what depth should the cultivation be given?

Activities.—Compare disk harrows, spike-tooth harrows, and other implements for cultivating asparagus. Manipulate the adjustments.

Cultivating Asparagus.—It is possible during the first year to grow some early truck crop, such as snap beans or lettuce, between the rows of asparagus. This practice, however, is not recommended by many of the best farmers. All cultivation should be shallow enough so as not to injure the crowns. Cultivation has to be given at frequent intervals in order to keep down weeds. Some hoeing is probably necessary each year, and especially the first year.

After the first year the beds should be disked and harrowed each year several weeks before the shoots are ready to start. In doing this care should be taken not to injure the crowns.

Mounding Asparagus.—If blanched asparagus is desired it will be necessary to mound the beds each spring just before the shoots start. This is usually done with a turning plow or with a disk harrow. After the cutting season is over these mounds are torn down and level cultivation is given.

Job 11. Controlling Enemies

Conditions Usually Found.—Asparagus rust is found in practically every community where asparagus is grown commercially. Asparagus is attacked by two species of beetles.

Aims.—Growers and students not familiar with asparagus rust and with the asparagus beetles should learn to identify them as well as how to control them.

Problems for Study and Discussion.—(1) Describe how asparagus rust appears on the plant.

2. How does the rust injure the marketed product?
3. What control measures are practised in your community for the rust?
4. What injury is done by the asparagus beetle?
5. How is this beetle controlled in your community?

Activities.—Collect specimens of diseases and insects and their work and study them carefully.

Asparagus Rust.—Asparagus rust is the only disease which does serious damage to asparagus. It appears on the plant as small spots,

reddish-yellow in color. Later the whole plant turns brown. No trace of the rust appears on the marketed product but the disease so weakens the plants that few profitable shoots are produced.

About the only practicable control measure for asparagus rust is the selection of resistant varieties.

Asparagus Beetles.—Both the common asparagus beetle and the twelve-spotted asparagus beetle will attack the plants. The common asparagus beetle is small, bluish-black in color, with a red thorax. The wing covers are yellow and dark blue.

The twelve-spotted beetle has a broader back and is orange-red in color with six black dots on each wing cover.

These beetles feed upon the tender shoots and later upon the stalks and berries. Some of the control measures practised by farmers are as follows: (a) Clean up all of the rubbish in the fall. (b) Keep the shoots cut in the spring and starve the larvæ. (c) Leave a few stalks in the spring on which the beetles may collect and then spray with arsenate of lead. (d) After the cutting season is over, spray all of the plants with arsenate of lead. (e) Dust the plants with air-slaked lime while the dew is on them to kill the larvæ of the common asparagus beetle.

Job 12. Harvesting, Grading, and Packing

Conditions Usually Found.—Asparagus is usually cut with a special knife, graded into two or three grades and packed for shipment.

Aims.—Young farmers should learn the importance of harvesting asparagus at the proper time. It is important that proper methods of grading and packing be learned.

Problems for Study and Discussion.—(1) Describe a knife used for cutting asparagus.

2. How old should an asparagus bed be before the shoots are cut for market?
3. What is the difference in method of cutting between green and blanched "grass"?
4. Why does it pay growers to wash asparagus?
5. What equipment is needed for washing asparagus?
6. How many grades do farmers in your community make in grading asparagus?
7. Describe the process of bunching asparagus.
8. What is the usual size of a bunch of asparagus?
9. What kinds of crates are used for shipping asparagus?
10. Why are the crates sometimes lined with paper or with moss? Of what value is this lining?

Activities.—Practise cutting, grading, and trimming asparagus for market.

Harvesting Asparagus.—No shoots should be cut until the third season. Some farmers, however, cut a little the second year. The shoots are cut for a period of 6 to 8 weeks each year, according to the weather and the prices. During the season the shoots are cut every day. A knife made for the purpose is used. The cutter holds the shoots with one hand and makes a downward stroke with the knife. Green asparagus is cut

only one or two inches below the surface of the soil but the blanched "grass" is cut about two inches above the crowns. Care must be taken not to injure the crowns in cutting blanched asparagus.

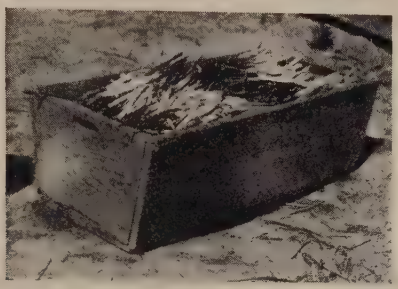

FIG. 248.—Asparagus is gathered in boxes in the field and taken to a packing place to wash, sort, bunch, trim, and tie. (John Miley, S. C.)

After the shoots have been cut they are placed in piles. These are picked up and put into boxes or baskets and carried to packing sheds. (Fig. 248.)

Washing Asparagus.—At the packing shed asparagus is put into wire-bottom trays and these trays are placed in water. The trays are

FIG. 249.—Grading and bunching asparagus. (John Miley, So. Car.)

pushed back and forth in the water until the shoots are clean. In some cases green asparagus is not washed.

Grading Asparagus.—(Fig. 249.) Cut asparagus is usually graded into three grades as follows: Fancy, No. 1, and No. 2. The U. S. Bureau of Markets designates grade No. 1 as "clean, fresh stalks of asparagus

which are no wilted or crooked; which do not show broken or spreading tips and which are free from damage caused by disease, insects, or mechanical or other means."

Bunching Asparagus.—After the shoots have been graded they are placed in a bunching machine, care being taken to place all the tips one way. When the bunching machine is full the clamps are closed and the bunch tied at each end with raffia or tape. The butts are then cut off evenly with a sharp knife (Fig. 250). The bunches vary in weight from less than one pound to three pounds.

Packing Asparagus.—The common crate for shipping asparagus is one 19½ inches long, 10½ inches wide at the top, 9½ inches wide at the

Fig. 250.—Bunching and trimming asparagus, using a bunching form and trimming knife. (John Miley, So. Car.)

bottom and 11 inches deep. These crates are usually lined with paper, with a layer of damp moss in the bottom, where the cut ends are placed. A crate will hold from 12 to 20 bunches, according to the grade which is being packed.

Job 13. Marketing Asparagus

Conditions Usually Found.—Farmers sell much of the asparagus crop by sending express shipments to commission men. Where a farmer has a number of acres of asparagus a carload shipment is sometimes made.

Aims.—The different terms and methods of marketing should be mastered.

Problems for Study and Discussion.—(1) What methods of marketing are used by the farmers of your community?

2. What is meant by an express shipment?
3. What are the advantages of a coöperative association for marketing asparagus?
4. To what extent do the farmers of your community make use of the market news service?

Activities.—Visit markets and places where asparagus is being prepared for market.

Marketing Asparagus.—Asparagus is harvested in the early spring just as the shoots appear, and the season lasts for six to eight weeks. Where growers have enough asparagus to ship in car lots every day they can secure better freight rates. The bulk of the asparagus crop is probably shipped by express. The crates are usually consigned to some commission man although in some sections men come to the asparagus section and buy the crates as they are brought to the station.

Job 14. Keeping Cost Records

(See corn enterprise.)

Things to Make at Home.—Bunching table; crates; field harvesting boxes; rack for bunching and trimming.

SALAD-CROP AND COLE-CROP ENTERPRISES

By Edward W. Garris

Analysis into Jobs.—This analysis includes celery and lettuce of the salad crops, and cabbage of the cole crops. These three crops are grown in much the same way and can be grouped together for study. References are made to U. S. Farmers' Bulletins. See garden books by Lloyd, Corbitt, and Bailey.

FIG. 251.—Lettuce is a field crop in the far south, where it is abundantly grown so that the far north may have its daily vitamines in winter as well as summer. (Agr. Agt. S. A. L. Ry.)

1. Determining possibilities in growing one of these crops.
2. Choosing the crop and variety. 433, 1269, 1418.
3. Selecting soil and field.
4. Growing cover crops, and providing organic matter.
5. Obtaining good seed and testing.

6. Preparing and managing the plant-bed.
7. Buying and mixing fertilizers.
8. Preparing the field for plants.
9. Setting the plants and fertilizing.
10. Cultivating the crop.
11. Controlling enemies. 1061, 1439, 1461.
12. Harvesting, grading, and packing. 1423.
13. Marketing.
14. Keeping cost account records. 511, 572, 782, 1139, 1182.

FIG. 252.—Head lettuce left; center, cos lettuce; and right, cress.

Job 1. Determining Possibilities in Growing One of These Crops

Conditions Usually Found.—These crops are grown only in limited areas as commercial truck crops. They are usually profitable crops when grown by experienced farmers.

Aims.—Students and growers should learn the exact requirements of each of these crops and what profit to expect in each case.

Problems for Study and Discussion.—(1) Which of these crops are grown in your community?

2. Find the acreage devoted to each crop.
3. What yields are made in your community for each crop?
4. Find average prices received last year for each of these crops.
5. What difficulties do farmers have with the growing of these crops in your locality?

6. How could you secure the proper amount of money needed in the growing of one of these crops?
7. Find the length of time necessary in each case for growing these crops.

Where These Crops Are Grown.—Celery is grown for home use in every section of the South, but only a few sections grow it for commercial purposes. The leading states in the United States for producing celery are Florida, California, New York, Michigan, Ohio and New Jersey.

Lettuce is found in home gardens in every part of the United States. The leading states which produce it for commercial shipping are California, New York, Florida (Fig. 251), and New Jersey.

Cabbage is also grown in home gardens in all sections of the United States. The leading states for producing cabbage are New York, Wisconsin, Pennsylvania, Virginia, California, Florida and Texas.

Yields Per Acre.—Yields for all these crops vary according to the soil and the seasons.

Celery usually produces from 500 to 750 crates per acre.

Lettuce produces from 250 to 700 hampers per acre.

Cabbage usually produces about 100 barrels per acre.

Cost Per Acre.—The costs for growing these crops vary with the rent of land, price of labor, and amount of fertilizer used.

The cost for growing celery is rather high, ranging from $400 to $700 per acre.

The cost for growing an acre of lettuce usually lies between $125 and $175.

Cabbage costs from $75 to $100 per acre.

Prices Usually Received.—The prices per crate for these crops vary from season to season. A farmer, however, should expect to secure the following prices:

Celery from $1.50 to $3.50 per crate.

Lettuce from $1.50 to $4.00 per hamper.

Cabbage from $1.50 to $3.50 per barrel.

Job 2. Choosing the Crop and Variety

Conditions Usually Found.—Farmers usually grow one of these crops and select one variety demanded by the market.

Aims.—The crop best suited to the soil available should be selected by students. They should understand the requirements of each of these crops.

Problems for Study and Discussion.—(1) Make a list of the varieties of celery grown in your community. Do the same for lettuce and for cabbage.
2. Discuss the advantages of the different varieties in the list.
3. Which varieties are preferred by the market in each case?
4. Of what importance is an early variety?

Variety to Grow.—The best varieties of celery grown for the market

in the South are the Golden Self-Blanching, Special, and Green Top. The Golden Self-Blanching leads all other varieties in popularity.

For lettuce the leading varieties in the South are Big Boston, Cream Butter, and Iceberg. Cos lettuce is another type (Fig. 252).

The leading varieties of cabbage for commercial shipping are the Jersey Wakefield, Charleston Wakefield, Flat Dutch, and Succession.

Job 3. Selecting Soil and Field

Conditions Usually Found.—Farmers usually select certain kinds of soil for each of these crops.

Aims.—Students and growers should learn the special soil requirements for each of these crops.

Problems for Study and Discussion.—(1) On what type of soil in your community is celery grown?

2. Of what importance is irrigation in growing celery?
3. On what kind of soil is lettuce grown?
4. What kind of soil is best for cabbage?
5. What crops should precede each of these truck crops on the field?

Soil Preferences.—Celery is grown on a low, moist, but well-drained soil. In many sections a muck soil is selected. In the celery-growing section of Florida a very fine sandy-loam soil, usually known locally as flatwood soil, is used. These flatwood areas are underlaid with impervious layers of clay, and artesian wells are easily bored. Drainage and subirrigation are both obtained from the same trench system.

Lettuce may be grown on all types of soil. Probably the best soil is a sandy loam. The soil for lettuce needs to be well drained but retentive of moisture.

Cabbage may be grown on all kinds of soils but for the early spring crop in the South, sandy-loam soils are used.

Job 4. Growing Cover Crops and Providing Organic Matter

This job is discussed under the melon enterprises.

Job 5. Obtaining Good Seed and Testing

Conditions Usually Found.—Farmers usually purchase seed for these crops and few ever test seed.

Aims.—Beginners should understand the importance of selecting good seed.

Problems for Study and Discussion.—(1) From what sources do farmers secure seed for celery, lettuce and cabbage?

2. In each case, how much seed will be needed to provide enough plants for an acre?
3. Discuss the advisability of saving seed for these crops.
4. At what time of the year would you order seed for each of these crops?
5. Describe a good method of testing seed for vitality.

Activities.—Practise testing celery, lettuce, and cabbage seed. Examine each lot for impurities, shriveled and small seed.

Sources of Seed.—A small amount of the celery seed planted is grown in the United States and the rest is imported. Practically every farmer depends upon purchasing seed from a reliable seedsman.

Lettuce and cabbage seed is also purchased from a reliable seedsman.

Amount of Seed.—The amount of seed needed for growing plants for an acre of celery will probably not be more than 2 to 3 ounces. It is best though to allow from 4 to 6 ounces because the seed are very small and all of them may not germinate.

The amount of lettuce seed needed will depend upon whether the seed is to be planted in the permanent row or in the plant-bed. The amount of seed will probably range from 1 to 3 pounds per acre.

For cabbage seed sown in the plant-bed from 4 to 6 ounces of seed should produce enough plants to set an acre.

Testing Seeds.—Seed is tested for vitality as suggested for testing melon seed under that enterprise. (See "Seed Treatment" in Appendix.)

Job 6. Preparing and Managing the Plant-Bed

Conditions Usually Found.—Most farmers grow their own plants. A special bed is usually prepared and care given the young plants.

Aims.—The importance of securing good plants and methods of growing them should be understood by students.

Problems for Study and Discussion.—(1) What kind of plant-bed is used for growing these plants?

2. Describe the methods used for protecting celery beds from the sun.
3. Find whether any farmers ever use hotbeds for growing these plants.
4. At what time of the year would you plant the beds for celery, lettuce and cabbage?
5. Discuss the advisability of purchasing plants rather than growing them.
6. How do farmers sow celery seed in the bed?
7. Discuss the management of a plant-bed.

Activities.—Make plant-beds, sow seed, and manage the crops while growing. Offer plants for sale.

Kind of Plant-Bed.—Very few farmers ever use a hotbed in growing plants for any of these crops. Seed is planted in the open for cabbage and celery beds; and sometimes lettuce beds are covered to protect them from the sun.

In the celery district of Florida seed-beds are prepared in July. The other states in the South probably plant them in August. After the beds are laid off, the seed is sown in drills across the bed and the bed wet down and covered with burlap bags until the seed starts to germinate. After the young plants are up they are protected from the sun by muslin stretched on stakes over the bed. These covers are removed when the weather begins to get cool.

Lettuce plants may be grown in hotbeds as are tomato plants. In many cases, however, the plants are grown in coldframes.

Cabbage plants are usually grown in the open. It is advisable to plant the seed in an open field but in as well protected a place as possible.

Planting the Seed.—Celery seed are very small and even an experienced person may sometimes have trouble in planting them evenly. They are mixed with fine sand, corn meal, or flour to help in sowing them over the bed. The seeds are usually sown in drills and covered very lightly with fine soil.

Lettuce may be sown by hand or with a seed drill. The seed is covered about one-fourth of an inch deep.

Cabbage seed are either sown in drills or broadcast over the plant-bed. The seed are covered approximately one-half inch deep.

Purchasing Plants.—It is a common practice for farmers to purchase cabbage plants, and sometimes celery and lettuce plants may be purchased. If the plants are purchased they should be secured from a local grower, if possible, because the plants do not live if kept for several days. The following numbers of plants are suggested for each crop:

For celery, 60,000 plants per acre. For lettuce, 30,000 plants per acre. For cabbage, 7,000 plants per acre.

Job 7. Buying and Mixing Fertilizers

Conditions Usually Found.—Farmers use commercial fertilizers in the growing of these crops. Few of them ever home-mix these fertilizers.

Aims.—Young farmers should learn what fertilizers are necessary for each of these crops and how to mix the fertilizers for any desired formula.

Problems for Study and Discussion.—(1) Find from local farmers the kind of commercial fertilizers used for each of these crops.

2. At what rate is the fertilizer applied in each case?
3. What are the advantages of coöperative buying of fertilizers?
4. How many applications of fertilizer are given in each case?
5. Discuss the advisability of using barnyard manure for these crops.
6. What are the advantages of home-mixing of commercial fertilizers?

Activities.—Collect tags for fertilizers used on these crops, and compare the mixtures in suitability.

Fertilizers for Celery.—Organic matter is very important in growing celery. It may be supplied by the application of barnyard manure or castor pomace, or by turning under the vegetable matter produced on the land after the celery crop. Castor pomace is applied at the rate of 1000 to 2000 pounds per acre several weeks before the plants are set.

The best commercial fertilizers for celery probably vary with the types of soil. Farmers differ in their opinion as to the best formula. Experiments would indicate that less phosphoric acid is needed than for the average truck crop. The usual formula used is a 5–5–5. It is applied at the rate of 2 to 4 tons per acre. The fertilizer is applied four or five times in different applications (Fig. 253).

Fertilizers for Lettuce.—The formula used by truck farmers varies with the section. Some farmers use a 5–5–5 fertilizer and others use a 5–8–5. The fertilizer is applied in two applications, the first application being given before the plants are set and the second application two or three weeks after the plants are set. Farmers use from 1 to 2½ tons of commercial fertilizer per acre.

Fertilizers for Cabbage.—Cabbage is usually considered to be hard on the land. Barnyard manure is applied at the rate of 5 to 10 tons

FIG. 253.—A school project. Agricultural students cultivating, fertilizing, and spraying in the famous celery section of Sanford, Fla.

whenever it is available. Where the manure is not used, commercial fertilizers are applied at the rate of about one ton per acre. Most farmers use a 4–6–4 or a 5–10–5 fertilizer for cabbage. In some cases, 200 pounds of nitrate of soda or sulfate of ammonia is applied per acre as a side dressing. (See Appendix.)

Job 8. Preparing the Field for Plants

Conditions Usually Found.—Farmers usually prepare the soil well before setting the plants in the field.

Aims.—The advantages of a well-prepared soil should be understood by students as well as the tools needed for such preparation.

Problems for Study and Discussion.—(1) Which is recommended, fall or spring plowing?

2. Discuss the advantages of deep preparation.
3. What implements are used in preparing the soil?
4. How far apart would you place the rows for each of these crops?
5. How are the rows marked?

Preparing the Soil.—The celery plants are usually set in early and late fall in the South, hence early fall preparation of the soil is necessary. The soil is turned to a depth of 6 to 8 inches to turn under all vegetation. The land is cut several times with a disk harrow in order to destroy the grass. Rows for celery are usually 30 to 36 inches apart.

Soils for cabbage and lettuce are prepared in much the same way as for celery. Lettuce plants are set about 16 by 16 inches and cabbage plants 12 to 18 inches in the row with the rows about 36 inches apart.

Job 9. Setting the Plants and Fertilizing

Conditions Usually Found.—Plants for these crops are usually set by hand.

Aims.—Students should understand how to set plants in the field.

Problems for Study and Discussion.—(1) Describe the practice of pulling plants from the bed.

2. How many inches high in each case should the plants be before transplanting them to the field?
3. How many persons compose a gang for setting celery plants?
4. Find from local farmers the cost for setting an acre of celery, lettuce or cabbage.
5. How many plants in each case are needed to set an acre?
6. How are the celery plants irrigated after they are set in the field?

Activities.—Compare different methods of transplanting by timing the operations in each case.

Pulling Plants from Bed.—For celery and lettuce, care must be taken in getting the plants from the bed. If the bed is thoroughly wet the plants may be pulled up by hand without damaging the root system. Some people take a trowel for removing the plants from the bed.

Cabbage plants may be pulled from the bed at any time, though just after a rain is probably the best time.

Setting Plants.—Most of the plants of celery, lettuce and cabbage are set in the field by hand. The field for celery is marked off for each row and for each plant. Plants are dropped where these marks cross and the plant setter sets them. The labor for setting an acre of celery is an expensive part of growing the crop. After the plants are set the field should be watered if possible. If lettuce and cabbage plants are set during a dry time it is necessary to put about a pint of water to each plant. For all plants it is important that the soil be pressed well around the roots of the plant so that contact is assured.

Job 10. Cultivating the Crop

Conditions Usually Found.—Farmers usually give these crops frequent shallow cultivation.

Aims.—The value of a good mulch on the soil and the reasons for shallow cultivation should be learned by growers.

Problems for Study and Discussion.—(1) What implements are used for cultivating these crops?

2. What time of day is best for cultivating these crops? Why?
3. How often would you cultivate these crops?
4. Discuss shallow cultivation versus deep cultivation.

Cultivating These Crops.—Cultivation should be shallow in order to prevent the destruction of roots. During the growing season the roots come near the surface of the soil and deep cultivation sometimes causes considerable damage. Cultivation should be frequent enough to keep down all weeds and grass. Riding cultivators of all kinds are used for cultivation.

It is best not to cultivate in the early morning when the dew is on the plants. The afternoon is the best time for cultivation.

Job 11. Controlling Enemies

Conditions Usually Found.—Farmers have to combat several different diseases and insects which damage these crops.

Aims.—It is necessary to learn to identify and control diseases and insects.

Problems for Study and Discussion.—(1) Find the diseases and insects in your community which injure these crops.
2. Discuss the treatment given by farmers in each case.
3. What type of spray equipment is used?
4. At what time during the day is celery sprayed?
5. What is the cost of spraying an acre of celery?

Activities.—Collect and study insects and diseases and their work.

Diseases of Celery.—The early blight, late blight, black heart and pink rot are the chief diseases of celery.

Blight.—In some respects, the late and the early blight are similar. The diseases attack all parts of the plant above the ground. The early blight first appears on the leaves as brown spots which later turn dark or grayish. These grayish masses are the spores. The spores of the late blight are black. The early blight may be controlled by thorough spraying with Bordeaux mixture. Farmers usually use the 4–4–50 formula for Bordeaux. The plants should be sprayed every week or ten days during the growing season. Bordeaux mixture also helps some in controlling the late blight. The seed may be treated before planting with hot water or with corrosive sublimate as a further safeguard.

Black-heart of celery attacks the young leaves of the growing heart, causing a black mass. The cause of the disease is not well understood, but experiments would indicate that the lack of proper water control and high temperatures may be some of the causes. It is necessary to drain the land well and to promote plant growth in general to prevent this disease.

Pink-rot is first seen by a damping off of the young plants. The plants fall over because the cells of the plant are weakened. A soft rot comes near the crown which later develops into a white, thick growth. The surface of the plant stalk later turns pinkish and develops irregular black

spores. These spores live over in the soil. The only safe control measure is the destruction of all diseased plants and the rotation of crops.

Diseases of Lettuce.—The common diseases of lettuce are drop, mosaic, anthracnose, bottom-rot and tip-burn.

The drop attacks the plants, causing a soft rot and making the plant drop. The plant has a white fungus on the under side of the leaves and later the spores may be seen as little black nodules. The disease often causes considerable damage and no practical remedy has been found other than removing the diseased plants.

Mosaic disease is probably spread by a species of aphis. It is similar to mosaic disease found on other truck crops. The control measure is to keep the plants free from all kinds of aphis by spraying with nicotine sulfate.

Anthracnose appears as water-soaked spots which later turn brown. The brown areas later drop out, leaving the leaves with small holes. The proper rotation of crops helps to check this disease.

Bottom-rot attacks the plants at any stage but usually causes more damage to young plants. The entire head may rot, or just parts of the leaves which touch the soil. The control measures are thorough cultivation and proper drainage.

Tip-burn causes damage to the tips of the leaves, especially in warm weather. No practical control measure has been found.

Diseases of Cabbage.—Cabbage may be attacked by root-knot, club-root, black-rot and black-leg.

Root-knot attacks many other plants besides cabbage. The parasite enters the roots of the cabbage plant near the tip and causes irregular swellings. Crop rotation is about the only practical control measure.

Club-root is similar to root-knot in that large knots are formed on the roots. The knots, however, are much larger than root-knot. The parasite causing this disease can live over in the soil and likes especially an acid soil. The application of lime and the rotation of crops are recommended as control measures.

Black-rot may appear at any stage of growth of the plants. The first appearance is shown by the yellowing of the leaves, which later turn black. The control measure recommended is the treating of the seed before planting, with corrosive sublimate. All diseased plants should be destroyed.

Black-leg usually attacks the young plants, the fungus killing the plants by clogging the stems and causing the plants to wilt. The fungus later develops black fruiting bodies which are full of spores. These spores can live in the soil. Crop rotation and treating of the seed as recommended for black-rot should help to control this disease.

Injurious Insects.—Insects which cause damage to these crops are thrips, aphis, cut worms and cabbage worm.

Thrips are small sucking insects which may be controlled by spraying with nicotine sulfate.

Aphis of all kinds are usually smaller than thrips. They suck the juice from the plants much as the thrips do, and may be controlled in the same manner.

Cut worms do considerable damage to young plants. Poison bait is recommended as a control measure.

The cabbage worm eats holes in the leaves and into the heads. The worm is green and about one inch in length. This worm may be controlled by spraying the cabbage with a poison spray such as arsenate of lead.

Job 12. Harvesting, Grading, and Packing

Conditions Usually Found.—These crops are harvested by hand. Most farmers grade the crops before packing for shipment.

Aims.—To get the students to know when and how to harvest each of these crops and to learn how to grade and pack them for shipment.

Problems for Study and Discussion.—(1) How can you tell when these crops are ready for harvesting?

2. Describe the method of harvesting practised in your community.
3. How is celery blanched?
4. Into what grades in each case are these crops sorted?
5. Describe the washing and grading of celery.
6. What kind of package would you use for each of these crops?
7. Find how farmers load a car of celery, lettuce or cabbage.

Activities.—Harvest each of these crops and prepare each in the best way for market. Visit places where packing is going on.

Blanching Celery.—When the celery stalks reach maturity it is necessary to blanch the stalks before harvesting. The blanching now is practically all done by means of a specially prepared paper about 10 to 12 inches wide. The paper is placed on the edge and kept close up to the celery on either side by means of a ∩-shaped wire, pressed into the soil. It takes from 10 to 14 days for the celery to be ready for harvesting after the paper has been placed (Fig. 254).

Harvesting Celery.—First the paper is removed and rolled up for future use. The plants are then cut from the ground by means of a cutter. Then the trimmers come along and lift the stalks and trim off all of the outer leaves. The stalks are then placed in piles ready for the packers. Usually a complete gang for harvesting celery is composed of 12 to 14 people.

In a majority of cases, the celery is packed in the field. Some farmers bring it to a packing house. In some cases the celery is washed at the packing house by means of a heavy spray of cold water which is forced through the stalks as they revolve on an endless belt.

Celery stalks are graded into sizes and the number for filling a crate may range from 4 to 10 dozen. The usual crate for celery in the South is 10 by 20 by 22 inches for inside dimensions. About 350 crates are counted a carload; and practically all of the crop is shipped in refrigeration.

Harvesting Lettuce.—Lettuce is usually harvested just as the heads get hard. The heads are cut by hand, the cutter using a long knife. In practice farmers seldom grade lettuce. It would probably pay however to

FIG. 254.—Blanching celery with heavy paper staked in place. (Agr. Agt. S. A. L. Ry.)

grade the heads into two grades. All dirty leaves should be removed from the heads.

In packing the heads the first layer in the hamper is placed with the stem end down; the top layer is reversed. Lettuce is shipped in many kinds of packages. Probably the most common package is the bushel hamper.

Harvesting Cabbage.—Cabbage for the early market is harvested just as soon as the heads reach marketable size. Heads weighing from 1 to 4 pounds are the best sizes for the market. The heads are cut with a knife just above the first outer leaves (Fig. 255). In practice the heads

are seldom graded closely, but it would probably pay to make at least two grades.

Cabbage is shipped in 1½-bushel hampers or in 60-pound and 120-pound crates. The crates are to be preferred because the cabbage can get better ventilation and can be packed better in the cars. Cabbage is usually shipped in refrigerator cars. The crates are given 2-inch ventilation space, double stripped; loaded 3 to 4 crates high, 7 wide, and 10 long.

FIG. 255.—Field of flat Dutch cabbage. (Lemon City H. S., Fla.)

Job 13. Marketing

Conditions Usually Found.—These crops are usually shipped in car lots an consigned to commission merchants, or sold by coöperative associations.

Aims.—Students and growers should understand the functions of marketing. The different ways of marketing should be understood so that the best methods may be selected.

Problems for Study and Discussion.—(1) Find from local farmers the methods used in marketing celery, lettuce and cabbage.

2. What is meant by consigning a car?
3. Find to what extent the farmers of your community use a market news service.
4. What advantages are to be expected from coöperative marketing?
5. What percentage of the crop of cabbage, celery or lettuce is sold to local buyers?
6. Discuss the matter of local express shipments.

Activities.—A trip to markets or to shipping points should be made to study methods.

Marketing.—The celery, lettuce and cabbage crops of the South are seldom stored, but are marketed as soon as they can reach the market. In many sections the farmers have organized coöperative associations. These associations are usually very valuable. These crops, when not sold

through coöperative associations, are often consigned by the grower to commission men. In some localities these commission men send buyers to purchase the shipments.

Job 14. Keeping Cost Records

(See forms for records in corn enterprises.)

Things to Make at Home.—Shipping crates; hand carts for harvesting; repair or make wagon frames.

ROOT-CROP AND BULB-CROP ENTERPRISES

By Edward W. Garris

Analysis into Jobs.—All of the root crops are hardy and may be produced in the South during the winter months. The root crops considered are table beets, carrots, and radish. Onions are also considered in the same discussion. References are made to U. S. Farmers' Bulletins. See vegetable garden books.

1. Determining possibilities in growing one of these crops.
2. Choosing the crop and variety. 354.
3. Selecting the soil.
4. Growing cover crops, and providing organic matter.
5. Obtaining seed and testing. 434.
6. Buying and mixing fertilizers.
7. Preparing the soil.
8. Planting the seed or setting the plants.
9. Cultivating the crop.
10. Controlling enemies. 1007, 1060.
11. Harvesting, grading, and packing.
12. Marketing.
13. Keeping cost account records. 511, 572, 782, 1182.

Job 1. Determining Possibilities in Growing One of These Crops

Conditions Usually Found.—Successful farmers seldom fail to produce profitable root and bulb crops.

Aims.—Students should understand the requirements for these crops and the profits to be expected in each case.

Problems for Study and Discussion.—(1) Which of these crops are grown commercially in your locality?

2. Find the total acreage in your community devoted to each crop.
3. What prices were received during the last five years per acre for each of these crops?
4. Find from several farmers the cost for growing an acre of each crop.
5. Determine the length of the growing period for each of these crops.

Where These Crops Are Grown.—Beets, carrots and radishes are grown for express shipments in many section of the South. Few localities grow them in large enough quantities for carload shipments.

Texas leads all of the states in the South in the production of onions. The shallot onion is grown to a considerable extent in Louisiana. All of the other states produce some onions for the market.

Yields Per Acre.—Onions yield from 100 to 400 crates per acre, according to fertility of the soil, seasons and management.

The yields of beets, carrots and radishes vary so much that is it hard to state the number of crates per acre.

The cost per acre for these crops varies with the section. The root crops should not cost more than $100 per acre, and onions probably cost about twice that amount. The cost per acre for onions depends greatly on whether or not the plants are transplanted.

Prices Usually Received.—Prices will vary from year to year and during different times of the same season. A farmer should expect to receive not less than $1.50 to $3.00 per bushel crate for these crops.

Job 2. Choosing the Crop and Variety

Conditions Usually Found.—One variety is usually selected by farmers for each of these crops. Market demands help to determine the variety selected.

Aims.—Beginners should learn the advantages of selecting the variety demanded by the market and the advantages of growing one variety.

Problems for Study and Discussion.—(1) Make a list of the varieties of each of these crops grown in your locality.

2. Find the best variety in each case for the market.
3. What are the advantages of growing only one variety?
4. How are new varieties obtained?

Variety to Grow.—There are quite a number of good varieties of belts offered by seedsmen. The principal varieties grown for the market are Crosby's Egyptian, Crimson Globe, Extra Early Eclipse, and Detroit Red.

The leading varieties of carrot are probably the Scarlet Horn and Danvers Half Long.

There are a number of good varieties of radish and the leading ones are the Scarlet Turnip, Scarlet Globe, and Long Scarlet Short Top.

The best varieties of onion for commercial planting are Crystal Wax, White Bermuda, and Australian Brown. The shallot is grown in considerable quantities in certain sections of Louisiana.

Job 3. Selecting the Soil

Conditions Usually Found.—Certain soils are usually selected by farmers for each of these crops.

Aims.—Growers should learn the exact soil requirements for each of these crops and learn how to select these required soils.

Problems for Study and Discussion.—(1) Find what soils in your locality are used for growing these crops.

2. Why is a sandy loam usually selected for the early crop?
3. How can a heavy soil be modified to suit root crops?
4. What is the importance of depth of soil for root crops?

Selecting Soils.—These crops are grown on a variety of soils, from the sandy soils to the heavy clays. Clay soils, however, are not so good as

other types because they have a tendency to bake. Sandy-loam soils are usually best for the early crop because they warm up early in the spring.

Silty and silty-loam soils are used to a considerable extent for onions in certain sections of Texas.

Job 4. Growing Cover Crops, and Providing Organic Matter

This job is discussed under the enterprise of growing melons.

Job 5. Obtaining Seed, and Testing

Conditions Usually Found.—Practically all of the seeds for these crops are purchased. Few farmers ever test seed.

Aims.—The advantages of good seed should be understood by students.

Problems for Study and Discussion.—(1) Where are the seeds obtained for planting beets, carrots, radishes and onions?

2. In each case, how much seed will be needed to plant an acre?
3. How many onion sets are needed to plant an acre?
4. How many onion plants are needed to set an acre?
5. At what time of the year would you purchase seed for each of these crops?
6. How are seed tested for vitality?

Activities.—Practise testing seed for these crops.

Sources of Seed.—Practically all of the seed for these crops are purchased by the growers from reliable seedsmen. The seed should be ordered several months before they are to be planted so that they will be available at the right time.

Amount of Seed.—The amount of seed needed varies with the method of planting. If the beet or onion seed is planted in the row where the plants are to mature more seed will be needed than for growing the plants in a bed. For planting these crops in the rows where the plants are to remain approximately the following amounts of seed per acre are required: onions—3 to 4 pounds; beets—4 to 6 pounds; carrots—2 to 3 pounds; radish—10 to 12 pounds.

Testing Seed.—These seed are tested for vitality as suggested for testing melon seed. (See "Seed Treatment" in Appendix.)

Job 6. Buying and Mixing Fertilizers

Conditions Usually Found.—Barnyard manure is especially good for these crops but farmers usually apply commercial fertilizers in addition.

Aims.—Students should know the best fertilizers for each of these crops and should be able to mix any fertilizer formula.

Problems for Study and Discussion.—(1) At what rate is barnyard manure applied?

2. Find from local farmers the kinds of commercial fertilizers used.
3. Discuss the advantages of coöperative purchasing of fertilizers.
4. How many different applications of fertilizer would you make for these crops?
5. Determine whether or not it would pay you to home-mix fertilizers.

6. Determine which fertilizer materials are cheaper per pound of plant food.

Activities.—Practise mixing fertilizers for root and bulb crops.

Fertilizers for These Crops.—Barnyard manure is very important in growing each of these crops. It should be applied at the rate of 15 to 20 tons per acre and best results are probably obtained by applying the manure to some preceding crop, on account of the weed seed. Poultry, sheep or goat manure is excellent, especially for onions. All these crops need a good supply of plant food.

If no manure is used, commercial fertilizer analyzing 4–8–4 or 6–5–5 (N–P–K) is applied at the rate of 1000 to 2000 pounds per acre. Usually this amount is applied in several applications, a part being put out before planting and then the rest applied to the growing plants. In some cases about 200 pounds of nitrate of soda or sulfate of ammonia is scattered between the rows as a side dressing.

Job 7. Preparing the Soil

The soil is prepared for these crops much as for the other truck crops discussed in this book.

Job 8. Planting the Seed or Setting the Plants

Conditions Usually Found.—Carrot and radish seed are always planted in the rows where they are to grow (Fig. 256). Beet and onion seed may be planted in the same way, or the plants may be grown in a bed and transplanted to the field.

Aims.—Farmers should learn how to plant these seed and how to set the plants in the field.

Problems for Study and Discussion.—(1) How deep would you cover the seed in each case?

2. Find which is cheaper: to grow beet and onion plants and then transplant them, or to plant the seed in the row where they are to grow. Which method gives the better yield?
3. When would you plant each of these crops in your locality?
4. Should a farmer grow his beet and onion plants or buy them? Why?
5. Where could beet and onion plants be obtained? How many in each case will be needed to plant an acre?

Planting the Seed.—It is always well to have a good seed bed for planting any of these crops. The seed are usually planted in drills, and a drill planter may be used. These crops may be planted in the South during the winter months or in the fall or spring.

In some cases beet and onion seed are planted in drills in a plant bed and the plants later transplanted to the field. Transplanting is rather expensive and can be justified only when prices are high. In practice more onion plants are transplanted than beet plants. The onion seed are planted in early fall and the plants transplanted to the field in December or January. From three to four pounds of seed furnish enough well-developed plants for an acre.

Setting Plants.—Beet or onion plants should be set just after a rain, or else a small amount of water should be applied to each plant. The plants are set by hand, and the process is very expensive. Onions, beets and carrots are usually placed in rows about two feet apart. In some cases, radish seed are planted broadcast over the land. It takes approximately 90,000 onion plants or 100,000 beet plants to set an acre.

Job 9. Cultivating the Crop

Conditions Usually Found.—Frequent cultivation is given all of these crops. More of the cultivation is given with mule-drawn implements than for many other crops.

Aims.—The reasons for cultivation and the implements best suited to cultivating onions, beets, carrots and radishes should be known by the young farmer.

Problems for Study and Discussion.—(1) Find the kinds of implement used in your locality for cultivating these crops.

2. How often would you cultivate these crops?
3. Would you cultivate by hand or use horse-drawn implements? Why?
4. To what extent is hand weeding necessary?

Activities.—Compare implements used and study their adjustments.

Cultivating These Crops.—Clean cultivation is necessary to keep down weeds and to keep a mulch. Most farmers recommend shallow cultivation, although the root system would not be injured by deep plowing. In many cases the cultivation is done by hand with a wheel hoe with cultivator attachment. On a large scale, however, a weeder drawn by a mule is used. Especially in the cultivation of onions will hand cultivation be necessary even if some cultivation is given with the riding cultivator.

Job 10. Controlling Enemies

Conditions Usually Found.—Some diseases and insects have to be controlled in growing these crops. Growers sometimes fail in this.

Aims.—Farmers and students should learn to identify these pests and master the methods of control of each.

Problems for Study and Discussion.—(1) What diseases are injurious to these crops in your community?

2. Discuss the control measures in each case.
3. Make a list of harmful insects for each of these crops.
4. How are the insects controlled?

Activities.—Collect and study insects and diseases which affect these crops.

Diseases.—The main disease of beets is probably the *leaf spot.* This disease causes holes in the leaves and also causes them to die. It is recommended that all refuse be burned after the beet crop is harvested, and that rotation of crops be followed.

Few diseases ever give any serious trouble in growing carrots and radishes.

Onion smut does some damage in certain sections of the United States but at present it has not done much damage in the South. The *onion*

mildew affects the plants, causing them to turn yellow and die. Burning all refuse in the field and rotating crops are recommended as control measures.

Insects.—Few insects cause enough damage to beets, carrots and radishes to require any control measures.

In many cases the *onion thrip* does considerable damage to the onion crop. These thrips are yellowish in color and cause the damage by sucking the juice from the leaves, which later turn yellow and die. Where the damage is serious spraying with nicotine sulfate and soap may help to control them.

The *onion maggot* often causes damage by burrowing into the bulbs and causing them to decay. The eggs of these maggots are laid by a fly which resembles the house fly except that it is smaller. The only control measure which has been found worth while is to poison the adult flies with a poison bait made of arsenate of lead and water sweetened with molasses.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—The root crops are harvested by hand as soon as they reach marketable size. Farmers sometime plow up onions and trim them by hand. The crops are usually graded.

Aims.—Managers should learn when to harvest these crops and how to grade and pack them for market.

Problems for Study and Discussion.—(1) At what stage would you harvest each of these crops?

2. How is each of the root crops prepared for market?
3. To what extent would you grade the root crops?
4. How are onions cured?
5. Find which packages are used in shipping these crops.

Activities.—Practise harvesting these crops. Trips should be made to places where grading and packing is being done.

Harvesting Root Crops.—All the root crops are pulled by hand just as soon as they reach the proper size. Beets are pulled when they attain a diameter of one to two inches. The small sizes are marketed as baby beets. Carrots are usually one-half to one inch in diameter. These root crops are pulled by hand, washed, graded into different sizes and bunched. The number in a bunch depends upon the size but usually varies from 6 to 12. As a general rule the tops are left on. (Fig. 256).

The root crops are packed in crates and hampers for shipment. The cabbage barrel-crate and the bushel hamper are used more than any others.

Harvesting Onions.—Onions are sold to some extent as green bunched onions. They are pulled by hand just as soon as the bulbs reach sufficient size, washed, graded, and bunched.

Bermuda onions are often harvested early on account of the good price during the early season. In many cases the onions are harvested before

the tops have ripened. They are usually plowed up with a turning plow and let dry in the sun until they are at least partly cured. The tops are then removed and the bulbs graded into sizes. The best package for onions is probably the bushel crate. The crates are usually loaded in ventilator cars for shipment to market.

FIG. 256.—Field of carrots. Examining for enemies. Florida State Dept. of Agriculture.

Job 12. Marketing

Conditions Usually Found.—Farmers sell these crops to local buyers, by consigning express shipments, and by consigning carload shipments.

Aims.—Students should learn the different methods of marketing and find the best method for each of these crops.

Problems for Study and Discussion.—(1) Find the methods of marketing used by the farmers in your community for each of these crops.

2. To what extent are these crops sold by consigning express shipments?
3. Discuss the type of car for shipping onions.
4. Which is better, to sell to local buyers or to consign these crops to commission men in various cities? Why?

Activities.—Methods of markets should be studied by visiting markets and shipping points.

Marketing These Crops.—In many sections local buyers are located in the sections producing these crops. A farmer is always certain as to the price he will get when he sells to a local buyer. These crops are usually consigned to commission men either by express shipments or carload shipments.

Job 13. Keeping Cost Account Records

See corn enterprise.

Things to Make at Home.—Repair or make parts for hand seeders and cultivators; narrow row markers, hand drills for dropping seeds; washing troughs, trays and benches.

BEAN ENTERPRISE

By Edward W. Garris

Analysis into Jobs.—The bean crop in the South can be divided into two distinct kinds, snap or string beans and lima beans. This study considers the production of green beans for shipping to the market. References are to U. S. Farmers' Bulletins. See garden books by Lloyd, Corbitt, Thompson, and Bailey.

1. Determining possibilities in growing beans for market.
2. Choosing the variety to plant.
3. Selecting soil and field.
4. Growing cover crops and providing organic matter.
5. Obtaining good seed and testing.
6. Buying and mixing fertilizers.
7. Preparing soil for planting.
8. Planting the seed.
9. Cultivating beans.
10. Controlling enemies. 1273, 1407.
11. Harvesting, grading, and packing.
12. Marketing beans.
13. Keeping cost records. 511, 572, 782, 1182.

Job 1. Determining Possibilities in Growing Beans for Market

Conditions Usually Found.—Beans are grown for the early market in many sections of the South. Experienced farmers seldom fail to produce satisfactory yields.

Aims.—Students should learn whether or not farmers usually make profit in producing beans for market.

Problems for Study and Discussion.—(1) What is the average yield per acre for beans?

2. Find the highest, lowest, and average prices received for beans last year in your community.
3. What is the average cost per acre for growing beans?
4. To what extent are beans attacked by any serious diseases or insects? Which ones cause the most damage?
5. How long does it take to grow a crop of beans?

Where Beans Are Grown Commercially.—The leading states in the production of green string beans are Florida, New York, New Jersey, Maryland, Tennessee, California, Kentucky and Virginia. All of the states in the South produce some string beans for the market.

Lima beans are grown in practically every state in the South for market, though to a much less extent than string beans. California produces much of the dry lima-bean crop.

Yields Per Acre.—The yields of string beans vary according to the soil and the season; however, a farmer should expect to produce from 75 to 250 hampers per acre. The yields of lima beans are usually about two-thirds that of string beans.

Cost Per Acre.—The costs per acre of growing beans vary in different sections with the cost of labor, the amounts of fertilizers used, the rent of the land, the amount of spraying done, and other factors. On an average, an acre of beans should not cost more than $75.00. The range may be from $50.00 to $85.00 per acre.

Prices Usually Received.—The prices received for beans vary during the season. Usually the high prices are secured at the first of the season. The highest prices are commonly received during the months of November, January, February and March. Prices received vary from $1.00 to $4.50 per hamper for string beans and from $2.00 to $7.00 for lima beans. The average prices are hard to determine for the various sections of the country.

Time Required for Beans.—Beans of all kinds are produced in a short time. String beans are produced in 8 to 10 weeks and lima beans in 10 to 12 weeks. The bean crop usually matures early enough so that other crops may be planted on the same land.

Job 2. Choosing the Variety to Plant

Conditions Usually Found.—Farmers usually grow only one variety and try to select a variety which the market demands.

Aims.—Growers should learn what variety of bean is demanded by the market and the importance of planting only one variety.

Problems for Study and Discussion.—(1) What varieties of string beans are grown for market in your community?

2. Find what varieties of lima beans are grown in your community.
3. Find from farmers which is better on the market, green or wax string beans.
4. Explain why market demands differ in the various cities.
5. What variety of string and of lima beans would you plant?

Varieties of String Beans.—There are quite a number of good varieties of string beans. Many different kinds of classification have been suggested for the hundreds of varieties listed. The beans may be green or wax in color and may be bunch or pole.

The leading varieties of the bunch string beans (Fig. 257) grown for market are Giant Stringless, Stringless Green Pod, Refugee, and Red Valentine. All of these varieties are green beans. The following wax varieties are grown: New Davis White Wax, Wardell Kidney Wax, Rustproof Wax, and Black Wax.

The pole string beans are grown only in a limited way for shipping to the market. Probably the Kentucky Wonder is the best variety. The Cornfield variety is also grown to some extent.

Varieties of Lima Beans.—The lima beans may also be divided into the bush and the pole varieties. Few, if any, farmers ever grow the pole varieties for shipping to market. The bunch varieties may be further divided according to whether the seeds are large or small. Of the small-seeded type probably the Henderson Bush Lima (Dwarf Sieva) is the best variety. Of the large-seeded type the Fordhook Bush Lima is probably used more than any other one variety.

FIG 257.—Snap beans ready to pick and ship to the northern markets. (Agr. Agt. S. A. L. Ry.)

Job 3. Selecting Soil and Field

Conditions Usually Found.—Farmers usually select a sandy-loam soil for the early crop of string and lima beans.

Aims.—The advantages of selecting the proper type of soil for growing beans should be understood by students.

Problems for Study and Discussion.—(1) What kind of soil is used in your community for growing beans?

2. Why is a sandy-loam soil usually preferred?
3. To what extent is muck used for growing beans?
4. What would be some of the disadvantages of a muck soil?
5. Of what importance is drainage?

Selecting Soil for Beans.—Beans will grow on a great variety of

soils. On large farms where beans are grown for the early market the sandy-loam soils are selected. Beans do well on this type of soil and sandy-loam soil is ready to plant earlier than a heavy soil, thereby giving assurance of an early crop.

In certain sections beans are grown on muck soils. Muck soils produce a good yield but more danger of frost must be expected on such soils for the early crop.

In many sections a "hammock" is selected and the trees killed but left standing to protect the beans from light frosts. Well drained soils should be selected.

Job 4. Growing Cover Crops and Providing Organic Matter

This job is discussed under this topic for the melon enterprise.

Job 5. Obtaining Good Seed and Testing

Conditions Usually Found.—Farmers usually depend on buying bean seed for planting. Few farmers ever test seed.

Aims.—Students should understand the importance of selecting good seed.

Problems for Study and Discussion.—(1) Find from several farmers where they secure bean seed.

2. Discuss the advisability of a farmer saving his own seed.
3. How much bean seed would you need to plant an acre?
4. What is certified seed?
5. How would you test bean seed for vitality?

Activities.—Practise testing seeds.

Securing Bean Seed.—The general practice among truck farmers who plant beans is to purchase seed for planting. It is possible for seed to be saved by each farmer. Care will have to be taken to store the seed in a dry place because seed stored in a moist climate will soon lose its vitality.

Seed purchased should be from a reliable firm and not bought because the quoted price may be low. Cheap seed usually gives a poor germination and in reality costs more than good seed.

The amount of seed needed per acre depends upon the width between rows, the size of the seed and the method of planting. The drill method takes more seed than the hill method. For the drill method it usually takes from 40 to 60 pounds of bean seed to plant an acre.

Seed is tested for vitality by the method suggested under the melon enterprise. Treating seed with Semesan aids germination (see Appendix).

Job 6. Buying and Mixing Fertilizers

Conditions Usually Found.—Farmers usually purchase commercial fertilizers ready mixed.

Aims.—Beginners should understand the value of applying quickly available fertilizers for beans and should know how to home-mix fertilizers.

Problems for Study and Discussion.—(1) What kinds of fertilizers are used for beans in your community?
2. At what rates are commercial fertilizers applied per acre?
3. Discuss the advisability of applying nitrogenous fertilizers.
4. How much fertilizer material do farmers buy coöperatively in your community?
5. How many farmers home-mix fertilizers?
6. Find if it will pay to home-mix fertilizers.

Activities.—Practise mixing fertilizers for beans.

Fertilizers for Beans.—Since beans mature in such a short period it is very important that all fertilizers applied be readily available. It is best to put the fertilizer out a week or two before planting the seed. The bean plants can secure some nitrogen from the air, but for an early spring crop it always pays to apply some available nitrogen.

Farmers usually apply a complete fertilizer for beans. A fertilizer which analyzes 8 to 10 per cent of phosphoric acid, 4 to 5 per cent of nitrogen, and 4 to 5 per cent potash is applied at the rate of 400 to 800 pounds per acre.

Job 7. Preparing Soil for Planting

Conditions Usually Found.—The land is usually well prepared before planting the bean crop.

Aims.—Students should understand the value of a well-prepared seed bed.

Problems for Study and Discussion.—(1) What tools are used in preparing the soil for planting beans?
2. At what time of the year is the soil prepared?
3. Discuss the value of fall plowing.
4. Find how deep farmers usually prepare the soil for beans.
5. At what distances apart do farmers make the rows?

Preparing the Soil.—Beans should have a good seed-bed. The soil is usually prepared with a turning plow to the depth of 6 to 8 inches. This first preparation should be several weeks in advance of the planting time. It also pays to disk or harrow the land once or twice before laying off the rows for planting.

Job 8. Planting the Seed

Conditions Usually Found.—Bean seed is usually drilled-in by hand or with a seed drill.

Aims.—Students should understand the value of securing a good stand of beans.

Problems for Study and Discussion.—(1) What methods do farmers of your community use in planting beans?
2. How deep should the bean seed be planted?
3. How much seed will be needed to plant an acre?
4. Discuss the hill versus the drill method of planting beans.
5. What widths between rows are recommended for beans in your community?
6. At what time of the year would you plant beans?

Activities.—Practise planting bean seed at different rates for comparison.

Method of Planting.—Where a small acreage is planted to beans the hand method of planting is used, but for large commercial growers a seed

drill is employed. Special bean plates are made for most makes of corn planters.

Most growers prefer to use the drill method of planting. The hill method would probably be desirable on land badly infested with weeds.

The rows for beans are placed from 2 to 3 feet apart, according to the method of cultivation. Beans are easily killed by frost and are usually planted after danger of frost is over. In Florida the bean crop is planted during the fall and winter months.

Job 9. Cultivating Beans

Conditions Usually Found.—Beans are given frequent, shallow cultivation.

Aims.—The importance of good cultivation and the best methods of cultivation should be understood.

Problems for Study and Discussion.—(1) What implements are used in cultivating beans?

2. When would you give the first cultivation?
3. Discuss the advisability of deep or shallow cultivation.
4. How often would you need to cultivate beans?
5. Of what value to the crop is cultivation?

Activities.—Compare cultivating implements and study their adjustments.

Cultivating Beans.—The cultivation for beans should commence soon after the plants come up. Frequent, shallow cultivation is recommended. Usually not more than three or four cultivations will be necessary. The cultivation should not be given in the early morning when the plants are wet with dew, nor just after a rain. When the cultivation is given at such a time the spores of anthracnose may be spread.

Job 10. Controlling Enemies

Conditions Usually Found.—In the production of string and lima beans farmers have to fight insects and diseases.

Aims.—Students should learn to recognize the various insect and disease pests of beans and should know the method of control in each case.

Problems for Study and Discussion.—(1) Find out from farmers what diseases are injurious to beans in your community.

2. What control measures are practised for each disease?
3. Make a list of injurious insects.
4. What control measures are used for insects?

Activities.—Collect specimens of diseases and insects and their work for study.

Diseases of Beans.—Beans are attacked by several diseases which cause serious damage. Probably the more serious diseases are anthracnose, rust, and mosaic.

Anthracnose attacks the stem, leaves and bean pods. The spots on the pods are irregular in shape and pink in color, except that around the border will be seen an edge of dark red. Where the disease is severe practically no seed will be produced. The best remedy is prevention. Seed should not be saved from diseased stalks.

Rust is common in many sections of the South. It may be noticed on the leaves as reddish-brown spore masses. The leaves so attacked turn yellow and later dry up and fall off. This disease may be controlled by selecting rust-resistant varieties.

The mosaic disease causes light and dark green patches on the leaves. The disease, so far as is known, is carried over on the seed. The selection of disease-free plants for seed is recommended as a control measure.

Bean Insects.—A few insects are injurious to the green bean crop. Bean-leaf beetles, bean thrips, and bean aphids probably cause the most damage.

The bean beetle is rather small, reddish in color, with six black dots on the wing covers. This insect eats holes in the leaves. It may be controlled by spraying with arsenate of lead provided that the leaves are sprayed on the under side.

The bean thrip is grayish in color and does its damage by sucking the juice from the plants. If the thrips get serious they may be destroyed by spraying with nicotine sulfate.

The bean aphis is a small black louse. It sucks the juice from the plants and may be controlled by methods recommended for bean thrips.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—Beans are hand-picked and packed in special crates for shipment.

Aims.—Farmers should learn to know when beans are ready for harvesting. It is also important to know how to pick beans and how to pack them for market.

Problems for Study and Discussion.—(1) What price is paid per hamper for picking beans?

2. At what stage would you pick string beans? Lima beans?
3. How would you protect beans from injury during harvesting time?
4. Discuss the method of grading beans.
5. What different packages are used in your community for shipping beans?
6. What kind of package would you select? Why?

Activities.—Practise picking and grading beans for market.

When to Harvest.—String beans are harvested just before the pods reach the normal size and before the seed mature. It is best not to let the bean seeds mature because at that stage the pods become tough and stringy.

Lima beans are harvested just as the seeds reach normal size and before the hulls begin to ripen.

Methods of Harvesting.—Both the string and the lima beans are picked by hand. The picker should exercise care in picking not to injure the young pods and blossoms. String beans are picked every 3 or 4 days and lima beans about once a week (Fig. 258).

Grading Beans.—Farmers spend very little time in grading beans. All of the diseased, worm-eaten or misshapen pods are removed but beans are not usually graded according to size.

Packing Beans.—The common crate for beans in the South is the bushel hamper. Other kinds of crate are used occasionally. The hamper should be given a shake two or three times during the packing in order that the beans may fill the hamper well. If the beans are not well packed in the hamper damage may be caused in transit.

Fig 258.—Harvesting snap beans. Overhead irrigation pipes are supported on the posts.

Job 12. Marketing Beans

Conditions Usually Found.—Farmers usually sell beans to commission merchants, consigning the hampers to them by express. Carload shipments are also made.

Aims.—Bean growers should learn the advantages of the different methods of marketing.

Problems for Study and Discussion.—(1) How much of the bean crop in your community is sold coöperatively?

2. Discuss the advantages of a coöperative association.
3. What is meant by consigning beans to commission merchants?
4. What methods of marketing do the farmers of your community use for selling the bean crop?
5. Find whether it pays to ship beans under refrigeration.

Marketing Beans.—In certain cases string beans may be shipped to market in carload lots, but usually they are shipped by express. The

bulk of the bean crop is probably sold by consigning express shipments to commission men in the various cities. Local buyers are found in some localities.

Many communities have formed coöperative associations for marketing beans. If managed right, the coöperative association should be of much help with such a crop.

Job 13. Keeping Cost Records

(See corn enterprise.)

Things to Make at Home.—Make up crates and baskets; repair or make racks for hauling beans; make stakes for pole varieties.

TOMATO, EGGPLANT, AND PEPPER ENTERPRISES

By Edward W. Garris

Analysis Into Jobs.—Since tomatoes, eggplants and peppers all belong to the same family and have practically the same cultural methods, they are grouped together for study. References are made to U. S. Farmers' Bulletins. See garden books by Lloyd, Corbitt, and Thompson.

1. Determining possibilities in growing one of these crops.
2. Choosing the crop and the variety. 1338.
3. Selecting soil and field.
4. Growing cover crops and providing organic matter.
5. Obtaining good seed, testing, and treating.
6. Locating, preparing, and managing the plant bed. 1431.
7. Buying and mixing fertilizers.
8. Preparing the field for plants.
9. Setting plants and fertilizing.
10. Cultivating, pruning, and staking.
11. Controlling enemies.
12. Harvesting, grading, and packing. 1291.
13. Marketing the crop.
14. Keeping cost records.

Job 1. Determining Possibilities in Growing One of These Crops

Conditions Usually Found.—(1) These crops are grown commercially in many sections of the United States. (2) Any one of these crops may be grown out of season in South Florida. (3) Experienced farmers usually produce satisfactory yields.

Aims.—Students should understand the soil and climatic requirements of each of these crops. They should also study the probable returns to be expected in each case.

Problems for Study and Discussion.—(1) To what extent are tomatoes, eggplants and peppers grown commercially in your community?

2. Ask several farmers how many crates of each of these crops are produced per acre.
3. Find the average prices received per crate for each of these crops during the past five years.
4. What is the average cost per acre in growing each of these crops?
5. What diseases and insects injure these crops?
6. Find whether farmers are increasing the acreage devoted to these crops.
7. What difficulties have farmers experienced in marketing these crops?

Where These Crops are Grown.—The leading states in the production of tomatoes are as follows: Maryland, New Jersey, California, Delaware, Virginia, Indiana, Florida, New York and Ohio. Part of the

crop in each state, except Florida, is probably grown for canning purposes. Tomatoes are grown to some extent in every state.

Eggplants are grown commercially in just a few states. New Jersey and Florida produce more for shipping than other states.

The leading states for producing peppers for commercial purposes are New Jersey, California and Florida.

Yields Per Acre.—The average yields of each of these crops vary from one section to another and for different seasons.

Tomatoes should yield from 75 to 250 crates per acre, depending upon the season and the kind of soil.

Peppers usually produce from 175 to 300 crates per acre.

The usual yields of eggplants per acre are from 200 to 400 crates.

Prices Usually Received.—The prices received per crate for each of these crops vary during the season and for different years. Florida usually receives the highest prices because these crops are marketed in the winter and early spring months. These crops should not bring, on an average, less than one dollar per crate. It is not unusual for a man to get $4.50 to $5.00 per crate for each of these crops at the first of the season. As a general rule, tomatoes probably bring more per crate than eggplants and peppers.

Cost Per Acre.—The costs for growing an acre of tomatoes, peppers, or eggplants vary, depending upon the cost of labor, the rent of land, the kind and amount of fertilizer used. In most cases the cost should not average more than $100 per acre. The cost probably varies between $75 and $125 per acre.

Job 2. Choosing the Crop and the Variety

Conditions Usually Found.—(1) Farmers as a rule grow only one variety. (2) Certain varieties are grown because of their ability to stand shipment well.

Aims.—Growers should decide which of these crops to grow and then select a standard variety.

Problems for Study and Discussion.—(1) Find which of these crops do best in your community.

2. Make a list of the different varieties grown in your community for each of these crops.
3. Which varieties would you select?
4. What are the advantages to a community of specializing in one variety?
5. Give examples of markets preferring certain varieties.

Variety to Grow.—In growing these crops for market, earliness is a very important factor. Market preference should also be taken into consideration. Probably the leading varieties of tomatoes are Livingston Globe, Early Detroit, Earliana, Stone, Marglobe, Bonny Best, and Beauty.

The leading varieties used for peppers are Ruby King, World Beater, and Bull Nose. The Pimento variety is used considerably for canning.

There are three distinct colors of eggplants: black, purple, and white. The black-fruited varieties are the most popular; and Black Beauty, New York Purple, and Florida High Bush are probably the leading varieties. In most sections, Black Beauty is decidedly the most popular variety for commercial planting.

Job 3. Selecting Soil and Field

Conditions Usually Found.—(1) Farmers select the field as near the shipping station as possible. (2) Disease-free soils are selected.

Aims.—Farmers should understand the importance of selecting soil which is free from disease and a field which is near the shipping station.

Problems for Study and Discussion.—(1) What soils in your community are used for growing these crops?

2. What rotations are practised by farmers?
3. Discuss the importance of selecting disease-free soil.
4. Why should the field be located near the shipping station?
5. What effect has the slope of the field on earliness?
6. Of what importance is soil drainage?
7. Find whether farmers prefer fertile soils for these crops.

Soil Preference.—These crops may be grown on a wide variety of soils and there is a difference in opinion as to the best soil. For the early spring crop, however, most farmers prefer a rich sandy-loam soil. Muck and clay-loam soils are also used in many sections.

Since several fungous diseases may live in the soil it is very important that soil be selected which is free from these diseases. The safe plan to follow is to provide for a rotation so that these crops are not grown often on the same soil.

Location of Field.—The fruits of these crops are easily bruised, therefore it is important to located the field as near as possible to the shipping station and to the packing shed.

Fields sloping to the south or to the southeast usually warm up earlier in the spring and make possible the planting of the crop a week or two earlier. Thick timber surrounding a field is valuable because of the protection it gives from light frosts.

Job 4. Growing Cover Crops, and Providing Organic Matter

The student is referred to this same job under the growing of asparagus.

Job 5. Obtaining Good Seed, Testing, and Treating

Conditions Usually Found.—(1) Farmers usually purchase the seed for planting these crops. (2) Few farmers ever test seed or treat them before planting.

Aims.—Beginners must understand the reason for obtaining good seed. They should also learn the value of testing and of treating seed before planting.

Problems for Study and Discussion.—(1) What methods of securing seed are practised by the farmers in your community?

2. Compare these methods of obtaining seed.
3. How long will these seeds keep their vitality in your locality?
4. How much seed of each crop is needed to furnish enough plants for an acre?
5. How may seed be treated for fungous diseases?
6. Describe the method of testing seed for vitality which you would use.

Activities.—Practise treating and testing seeds and compare seed from different sources.

Sources of Seed.—Seed of these crops may be saved and stored in a dry place until the next season. In practice, however, very few farmers save seed. Care should be taken to buy the seed from reliable seedsmen.

Seed stored in a warm, moist climate soon lose their vitality. For this reason, it is better to plant only seed which were grown the previous season.

Amount of Seed Needed.—It is always best to purchase more seed than is actually needed so as to allow for poor germination or injury which may happen to the young plants. Usually from 4 to 5 ounces of seed should furnish enough plants to set an acre. If these seed are to be planted in drills in the permanent row, then two or three times this amount will be needed. The practice of planting the seed in drills in permanent rows is followed by some farmers, especially for eggplants.

Testing Seed for Vitality.—After seed have been purchased a farmer should test them for their vitality so that he will know how thick they should be planted. Probably the best way to test seed is by the ragdoll method. (See melon enterprise.)

Treating Seed.—The fungous spores of several diseases live over on the seed. These spores may be killed by using Semesan or bichloride of mercury (corrosive sublimate) in water. Soak the seed for several hours in water and then in bichloride of mercury for 3 to 4 minutes or Semesan ¼%, 30 minutes. The seed should next be washed carefully in running water if bichloride of mercury is used. (See Appendix.)

Job 6. Locating, Preparing, and Managing the Plant-Bed

Conditions Usually Found.—The plant-bed is usually located near a good water supply and where protection from winds is available.

Aims.—The importance of locating the plant-bed properly and how it should be managed should be understood by students and growers.

Problems for Study and Discussion.—(1) What kind of plant-bed do the farmers in your community use?

2. What sources of heat do they use? Find which methods of supplying heat are considered the best.
3. Describe the construction of a hotbed.
4. What kind of soil is used in the hotbed?
5. What use do farmers have for a coldframe?
6. In practise how many times do farmers of your community transplant plants before setting them to the field? Discuss this practice.
7. What should be the temperature of the hotbed for planting seed?

8. How would you water a hotbed?
9. How much ventilation would you give a hotbed?
10. Give directions for daily opening and closing.

Activities.—Make plant-beds, sow seed, and manage the crops while growing. Try to sell plants, and keep records of the work.

Locating the Plant-Bed.—The bed for growing these plants should be located conveniently to the water supply, and it is best to locate it where protection from cold winds is possible. The south side of a building is good location.

Kind of Plant-Bed.—Many farmers who grow tomatoes, eggplants, or peppers raise their own plants in specially constructed hotbeds. Such beds have some form of heat from the bottom and are covered with either glass or white cloth. The beds are dug six feet wide and as long as desirable, in multiples of three feet.

The area for a bed is dug out to the depth of 12 to 15 inches. The frame is usually constructed of wood, although brick or concrete may be used. The frame is constructed two feet high at the north side and one foot high at the south side. The sash can be bought six feet long and three feet wide. The bed may also be covered with a good grade of white cloth which has been treated with linseed oil.

Kinds of Heat for Hotbeds.—The common method of securing heat for hotbeds is the use of fermenting horse manure. From 4 to 6 inches of manure is placed in the bottom of the hotbed and is wet with water. Then about 4 inches of prepared soil is placed on the manure.

The beds may also be heated by hot-water pipes or by placing stove pipes under the beds at intervals, making a smoke stack at the end opposite the fire-place. It is hard to regulate the heat in this type of bed unless a worker looks after the beds both day and night. If enough plants are being grown to pay for this labor, the heat from the stove pipes will prove satisfactory.

Soil for Hotbeds.—It is important that the soil for hotbeds be free from disease spores. Good soil for this purpose may be prepared by mixing equal parts of a rich loam soil, leaf mould secured from the woods, and cow manure. Four inches of this soil is placed in the bed for planting seed.

Sowing the Seed.—After the hotbed has been prepared and the temperature comes down to about 90 degrees the bed is ready for planting. The seed are usually sown in drills about four to six inches apart. The seed are covered from one-half to one inch deep.

Management of the Hotbed.—After the hotbed is planted care must be taken to keep the soil moist so that the seed can germinate. It is best to water the bed with a fine spray before and after the plants are up. The sash should be raised a little every day, if possible, to admit

fresh air and to keep the bed from getting too warm. An average temperature of 70 degrees should give the plants enough heat for good growing conditions. After the plants are growing the sash may be removed entirely during warm days.

Use of Coldframes.—Some farmers advise the use of coldframes to harden the plants before setting them in the field. A coldframe is like a hotbed except that no bottom heat is given. Plants from the hotbed are set in two-inch checks in the coldframe and become stocky in a few days. Plants may be somewhat hardened in the hotbed by giving them only a limited amount of water.

In order to get tomatoes on the market early some farmers practice covering an acre or two of land with cloth, as in preparing a field for growing shade tobacco. The plants are set out in one-foot checks. After all danger of frost is over these plants are watered well and dug up with a shovel of dirt with each plant and set in the field. This method is called "spotting." The plants are about ready to bloom when they are transplanted to the field.

Job 7. Buying and Mixing Fertilizers

Conditions Usually Found.—In addition to barnyard manure most farmers use commercial fertilizers. Coöperative buying and home-mixing of fertilizers are becoming more popular in many sections.

Aims.—Young farmers should learn what special fertilizers are best for each of these crops. They should understand the advantages of coöperative buying of fertilizers and of home-mixing.

Problems for Study and Discussion.—(1) Find what kinds of fertilizer are being used by farmers in your community for each of these crops.

2. At what rate is the fertilizer applied for each crop?
3. Make a list of the advantages of buying fertilizers coöperatively.
4. To what extent do farmers of your community use top dressing for these crops?
5. Why should available forms of fertilizers be used for growing these crops?
6. How many farmers in your community home-mix fertilizers?
7. What reasons do they give for or against this practice?

Activities.—Collect tags for fertilizers used on these crops, and compare the mixtures in suitability.

Fertilizers to Use.—One of the best fertilizers for tomatoes, eggplants and peppers is stable manure. It should be applied at the rate of 10 to 15 tons per acre. In many cases only 5 to 6 tons are applied and then some commercial fertilizer is used.

Commercial fertilizers analyzing from 8 to 10 per cent phosphoric acid, from 4 to 5 per cent nitrogen, and from 4 to 6 per cent potash should be suitable for most of the soils in the South. Commercial fertilizers are applied at the rate of 800 to 1000 pounds per acre. In addition to this, many farmers apply about 100 pounds of nitrate of soda or sulfate of ammonia just as the plants commence to bloom.

Home-Mixing Fertilizers.—Where farmers need different formulas of fertilizers in growing truck, it is often desirable to purchase the materials separately and mix them at home. In doing this the farmer is certain of the materials which make up his mixture. Mixing of fertilizers at home may not pay if only a small amount is used. (See fertilizer formula table in cotton enterprise.)

Job 8. Preparing the Field for Plants

Conditions Usually Found.—Farmers usually prepare the soil well before setting the plants in the field.

Aims.—Growers should learn to plan far enough ahead so that the fields will be ready when the time comes for setting the plants. They should know also what implements are needed in preparing the soil.

Problems for Study and Discussion.—(1) Which is practised in your community, fall or spring plowing?

2. Discuss the advantages of deep and of shallow plowing?
3. What implements do farmers use in preparing soil?
4. How does harrowing or disking plowed ground in the spring help to warm the soil?

Preparing the Soil.—The soil should be well prepared before the plants are set. The soil is usually turned 6 to 8 inches deep with a good turning plow. It is also a good practice to disk the land at least once after it has been turned. Early crops develop rapidly if the soil is warmed by harrowing several times after plowing and disking.

Job 9. Setting Plants, and Fertilizing

Conditions Usually Found.—Beginners have much to learn in transplanting plants. Experienced growers seldom fail to get plants to live.

Aims.—Students and growers should learn the best methods of transplanting plants in the open field, how to take plants from the bed, and how to fertilize plants.

Problems for Study and Discussion.—(1) Describe the best method to use in taking plants from the bed.

2. What sizes of plant are used for transplanting in the field?
3. Examine transplanting machines and learn how to operate them.
4. Find from several farmers of your community if a transplanting machine will pay for itself.
5. What is the average cost per acre for hand-setting plants?
6. Ask farmers which is better, hand or machine setting.
7. How are plants watered when they are transplanted?
8. How many plants for each crop are needed to set an acre?

Activities.—Compare different methods of transplanting to note costs and results.

Taking Plants from Bed.—The plants should be hardened before setting them in the field. This is done by withholding water or by transplanting them to a coldframe. Just before the plants are taken from the bed it is best to water the soil well so that the plants will pull out easily.

They are either pulled out by hand or dug up with a trowel. Plants should be several inches high before setting them in the field.

Setting the Plants.—Most farmers set the plants in the field by hand. It is possible to use a transplanting machine, but with tender plants better results are usually secured by hand setting. The rows are placed from 3 to 4 feet apart and the plants spaced at about the same intervals in the row. The pepper plants are sometimes spaced closer than tomatoes and eggplants.

Usually about a pint of water is poured in the furrow where each plant is set. The roots of the plant are placed in the water and as the water soaks up the soil is raked in from the sides and pressed well around the roots of the plant. Plants are usually placed a little deeper in the field than they were in the plant-bed. Tomatoes that are rather tall should lie down in the furrow with the top bent up. They will take root all along their stems. This is called "elbow" planting.

Job 10. Cultivating, Pruning, and Staking

Conditions Usually Found.—Most farmers cultivate these crops with improved farm implements.

Aims.—The value of cultivation and the most economical methods should be learned by growers.

Problems for Study and Discussion.—(1) What implements do farmers in your community use for cultivating these crops?

2. To what extent is hand cultivation practised? Describe implements used.
3. How often are these crops cultivated?
4. How long should the cultivation be continued?
5. Find how deep farmers cultivate these crops.

Activities.—Practise cultivating, pruning, and staking these crops.

Cultivating the Crop.—Cultivation should commence soon after the plants are set in the field. Frequent and shallow cultivation should be given and the cultivation continued until the plants begin to fruit. Some farmers use riding cultivators for cultivating these crops.

Pruning and Staking.—In certain localities tomatoes are pruned to a single stem and tied to stakes. The stakes may be made 1 by 1 inch and cut from 5 to 6 feet long. The stakes are driven about one foot deep in the soil. Staking costs considerable and many farmers who grow tomatoes doubt the economy of staking. Some of the advantages claimed for the practice are (1) larger fruit, (2) less injury from diseases and insects, (3) more conveniences for spraying and for picking the fruit, and (4) more crates of marketable fruit (Fig. 259).

Job 11. Controlling Enemies

Conditions Usually Found.—Farmers who grow these crops have to combat several different insects and diseases.

Aims.—Students and farmers should learn to identify diseases and insects attacking these crops and should know how to control them.

Problems for Study and Discussion.—(1) Make a list of the diseases which injure these crops in your community.

2. Find from local farmers what they do to control each disease.

Fig. 259.—When tomato vines are staked the fruit is kept clean by being off the ground. (Agr. Agt. S. A. L. Ry.)

3. What insects are injurious in your community?
4. Discuss the control measures practised for each insect.

Activities.—Collect and study specimens of enemies affecting these crops.

Diseases.—These crops are attacked by a number of diseases which cause considerable damage. Among the diseases which attack tomatoes are fusarium wilt, bacterial wilt, leaf spot, early blight, late blight, and blossom-end rot.

Eggplants are attacked by a wilt similar to that of tomatoes and by fruit rot.

Peppers are injured probably more by anthracnose than by any other disease. Mosaic and leaf spot are sometimes injurious.

Fusarium wilt may be recognized by the plant wilting and the leaves curling up. The fungus causing this wilt can live over from one year to another in the soil. The practical control measures are the selection of soil free from the disease, and the use of wilt-resistant varieties.

Bacterial wilt causes plants to die more rapidly. The stem discoloration is black rather than brown. The bacteria causing this disease enter through a bruise. Rotation of crops, keeping insects in check, and the prevention of injury to the plants are suggested remedies. The diseased plants should be destroyed just as soon as the disease is recognized.

Leaf spot first appears as a water-soaked place and later turns brown. Leaves so attacked dry up and fall from the plant. The best control measure is spraying the plants with Bordeaux mixture.

Early and the late blight are both similar in many respects to leaf spot. Both of the diseases can be held in check by spraying with Bordeaux mixture as recommended for the leaf spot.

Blossom-end rot attacks the fruit of tomatoes. The cause is not well known, but the disease is worse when the water supply is irregular. If properly used, irrigation may help control this disease.

Fruit rot of eggplant attacks the plant as well as the fruit. The spots start with a grayish blotch which later develops into a soft rot. Treating seed with bichloride of mercury (corrosive sublimate) will help to control this disease.

Insects.—Tomatoes are attacked by the hornworms and the tomato fruit worms. Eggplants are injured by flea-beetles, the Colorado potato beetles, and several kinds of aphids. In certain cases lace-bugs and tortoise beetles also injure eggplants. Peppers are attacked by practically the same insects as are eggplants.

Hornworms of tomatoes may be found on tobacco also. These are large green worms, the larvæ of the sphinx moth. Hand picking and spraying or dusting the plants with arsenate of lead are recommended as control measures.

Fruit worms of tomatoes are the same as ear-worms of corn. The worm prefers the corn and a few stalks planted along with the tomatoes will help to prevent injury to the tomatoes. Spraying with arsenate of lead will also help some.

Colorado potato beetles may be controlled by spraying with arsenate of lead.

Lace-bugs suck the juice from eggplants and may be controlled by spraying with nicotine sulfate.

Tortoise beetles eat holes in the leaves and may be held in check by spraying with arsenate of lead.

Job 12. Harvesting, Grading, and Packing

Conditions Usually Found.—Methods of harvesting vary from one section to another. Many farmers do not properly grade and pack these fruits.

Aims.—Students should learn the best methods of harvesting. They should learn to grade and pack these crops for shipment.

Problems for Study and Discussion.—(1) At what stage would you harvest tomatoes? Eggplants? Peppers?

2. Into what grades are these crops sorted?
3. What kind of package would you use for each of these crops?
4. Describe the method of packing tomatoes.

Activities.—Practise harvesting, grading, and packing each of these crops.

FIG. 260.—Everybody picks tomatoes on this truck farm.

When to Harvest.—When tomatoes are shipped to market they must be harvested just before the fruit begins to turn red. A brown ring appears around the stem cavity and the blossom-end turns a whitish-green at the proper stage for picking the fruit. A picker will soon learn to recognize the proper stage (Fig. 260).

The fruits of eggplants are edible from the time the fruits are small until they are fully grown. The fruit is usually cut from the vines about the time it is grown (Fig. 261).

Peppers are usually picked as they reach full size and before the pods begin to turn red (Figs. 262 and 263).

Prevention of Injury.—These crops should be handled with extreme care. If the fruit is injured it will probably be worthless when the market

FIG. 261.—A field of eggplant. Examining for maturity. (Agr. Agt. S. A. L. Ry.)

FIG. 262.—Trough peppers. A crop which is increasing in popularity. (Agr. Agt. S. A. L. Ry.)

is reached. Baskets or crates used by the pickers are often lined with some kind of soft material in order to prevent injury.

Fig. 263.—Picking green peppers.

Fig. 264.—Grading, wrapping and packing tomatoes. (Florida State Dept. Agr.)

Grading.—Tomatoes are sorted into two or three grades (Fig. 264). The grades are Fancy, Choice, and Gems. In the early season only two

grades are used. In grading it is important that no damaged fruit be packed. The fruit is sorted according to size.

As a general rule, peppers are not graded. Small fruits and any pods not properly shaped should not be packed.

The fruits of eggplants are usually graded to separate the sizes and to cull inferior fruits, but no definite grades are recognized by the markets (Fig. 265).

FIG. 265.—Grading and packing eggplant.
(H. E. Wood.)

Packing the Fruit.—The best grade of tomatoes is usually wrapped in tissue paper and packed like peaches in baskets. The crate used holds six baskets of fruit.

The fruits of eggplants are wrapped in tissue paper and packed in bushel crates.

Peppers are packed for market either in half-bushel crates or in bushel hampers.

Job 13. Marketing the Crop

Conditions Usually Found.—After these crops are packed for shipment they are either sold to local buyers or consigned to commission men.

Aims.—Growers should understand the best methods of marketing for each of these crops.

Problems for Study and Discussion.—(1) What methods of marketing are used by farmers of your community?
2. What is meant by consigning a car of tomatoes?
3. What are the functions of a marketing association or agent?
4. Of what value to farmers is the market news service?
5. List the advantages of coöperative marketing.
6. Find what percentages of these crops are shipped by express.

Activities.—Visits should be made to markets or shipping points and studies made of all methods.

Methods of Marketing.—Tomatoes and eggplants are often shipped in ventilated cars (Fig. 266). Tomatoes may be shipped under refrig-

Fig. 266.—At left; hauling crates of eggplant to load car at right. (H. E. Wood.)

eration but the expense is usually greater than the advantage is worth. Buyers often come to sections producing tomatoes, eggplants, and peppers and buy carloads ready for shipment. Large commission merchants often have buyers stationed in the producing areas to solicit shipments. The major part of the crop, however, is probably consigned by the producer to some commission man.

Job 14. Keeping Cost Records

(See corn enterprise.)

Things to Make at Home.—A marker for laying off three or four rows at once; stakes for plants; hotbed frames; spotting boards for transplanting in beds; plant trays; wooden hand dibbers. Ask truck growers what equipment they have made or would like to have.

MELON ENTERPRISES

By Edward W. Garris

Analysis Into Jobs.—The treatment given here considers the production and marketing of cucumbers, cantaloupes and watermelons. These crops are often grown on a large scale remote from the large markets and shipped to these markets in car lots. References are made to U. S. Farmers' Bulletins. See also vegetable gardening books by Lloyd, Corbitt, Thompson, and Bailey.

1. Determining possibilities in growing melons for market.
2. Choosing the crop and the variety. 254, 1394.
3. Deciding the area and selecting the soil and the field.
4. Growing cover crops and providing organic matter.
5. Obtaining good seed, testing and treating.
6. Buying and applying fertilizers.
7. Preparing the soil for planting.
8. Planting the field.
9. Cultivating the melons.
10. Controlling insect and disease enemies. 1499.
11. Harvesting, grading and packing the melons. 707.
12. Marketing the melons. 1145.
13. Keeping records. 511, 572, 782, 1139, 1182.

Job 1. Determining Possibilities in Growing Melons for Market

Conditions Usually Found.—(1) These crops are grown on a large scale where soil and climatic conditions are favorable. (2) Experienced farmers seldom fail to produce a satisfactory yield of melons.

Aims.—Students should consider the factors of soil, climate, shipping conditions, yields to be expected, and the probable returns on growing these crops.

Problems for Study and Discussion.—(1) To what extent are melons grown commercially in your community?

2. Find out from several farmers the average yield to be expected per acre.
3. Ask several farmers what prices are usually received.
4. In your community, what is the average cost of growing an acre of watermelons, cucumbers, or cantaloupes?
5. How could you secure the proper amount of capital needed for growing a melon crop?
6. How could you secure labor for helping at harvesting time?
7. Find out from farmers what troubles they have with insects or diseases.
8. To what extent are farmers increasing or decreasing the acreage devoted to melons this year? Why?
9. What difficulties have farmers in your community had in marketing melons?

Where Melons are Grown Commercially.—Melons may be grown in all sections of the United States, but as a commercial crop to be

shipped in car lots they are grown in restricted areas. According to the 1925 Yearbook, United States Department of Agriculture, the leading states for watermelons are as follows: Georgia, Florida, Texas, South Carolina, Alabama and Missouri.

Cantaloupes are grown extensively in the following states: California, Colorado, Arizona, Arkansas, Texas, Georgia, North Carolina, Virginia and Maryland. Commercial shipments are also made from Alabama, Mississippi, Florida and South Carolina.

The leading states for shipping cucumbers for slicing purposes are Alabama, Florida, Georgia, Louisiana, Texas and Virginia.

Yields per Acre.—The average yields of melons vary from season to season and from one state to another. It usually takes from two to three acres of watermelons to produce a carload; however, yields of a carload to the acre are sometimes produced. Cucumbers usually yield from 200 to 300 crates per acre and cantaloupes from 150 to 200 standard crates.

Prices Usually Received.—The prices per car for watermelons or per crate for cucumbers and cantaloupes vary from year to year and from one part of the season to another. As a rule, the high prices are received during the first of the season. Watermelons bring as much as $1,000.00 per car at the first of the season in Florida. Later in the season the production may be so heavy that the price will not pay for the freight on the car.

Cost of Growing Melons.—The cost of growing melons will also vary from one section to another, with the rent of the land, the amount of fertilizer used, the amount and price of labor. The cost of growing a car of watermelons, however, should not be more than $50.00 to $75.00.

The cost per acre of growing cantaloupes and cucumbers is usually greater than the cost of growing watermelons.

Job 2. Choosing the Crop and the Variety

Conditions Usually Found.—(1) Usually one community will specialize in growing only one kind of melon. (2) Commercial growers usually select one good variety.

Aims.—(1) The different requirements of these crops should be understood by students. (2) The importance of certain varieties for shipping purposes and the importance of growing only one variety in a community should be learned.

Problems for Study and Discussion.—(1) Find which of these crops do best in your community.

2. Make a list of the different varieties of watermelon which you have seen in your community. Do the same for cucumbers and for cantaloupes.
3. What are the disadvantages of growing several varieties of melon in your community?
4. Should a farmer's field be the place for trying out new varieties? If not, why not?
5. What are some of the requirements of a good watermelon for shipping purposes? State the same for cucumbers and for cantaloupes.

6. What is meant by a variety being susceptible to disease? What are immune varieties? How are they established?

Variety to Grow.—In order to stand shipment well a watermelon should have a rather tough, thick rind. A long melon is better than a round one because the long melons can be packed in the car better. Melons are shipped which weigh from 18 to 36 pounds. The leading commercial varieties are Tom Watson, Irish Grey and Excel. The Tom Watson melon has a dark green rind and a deep red flesh. The quality is good.

Fig. 267.—Hill of cantaloupes ready for harvest. (Courtesy Agr. Agt. S. A. L. Ry.)

The Irish Grey melon is a little smaller than the Tom Watson but is much better in quality. Its name indicates the color of the rind.

The Improved White Spine cucumber is probably the leading commercial variety in the several states. The Davis Perfect and several other varieties are used in certain localities.

For cantaloupes (Fig. 267) the Rocky Ford is still one of the leading varieties. Other good varieties include Jenny Lind, Emerald Gem, Pollock and Pink Meat. All of these varieties are of the netted type. The Honey Dew melon is now being grown in many localities. The fruit of

this melon is medium in size and carries no netting. The flesh is thick and has good texture and quality.

Job 3. Deciding the Area and Selecting Soil and Field

Conditions Usually Found.—(1) When prices have been high the year before, many farmers are inclined to plant too large crops. (2) The choice of the field and the soil is very important, especially to people without experience.

Aims.—(1) Beginners should learn to detect differences in soil for each of these crops. (2) They should understand why it is best to select fields near the shipping station. (3) Care should be taken to select fields where suitable preceding crops have grown. (4) They should never undertake a very large area.

Problems for Study and Discussion.—(1) Find out from local growers the exact kind of soil best for watermelons, cucumbers, and cantaloupes.

2. What rotations are practised by these farmers?
3. Why should the field be near the shipping station?
4. What was the average size of the field devoted to melons last year?
5. Are the melons in your community ever damaged by the wind? Discuss windbreaks.
6. Why should growers not plant melons on soil infested with nematodes or with diseases?

Kind of Soil.—The soil best adapted to growing watermelons is a fertile, well drained, sandy-loam soil with a clay subsoil. The other melon crops also do well on this type of soil. It is very important that the soil selected be free from disease and nematodes. A rotation in which melons are grown every fourth or fifth year ought to help keep these diseases in check.

Location of Field.—The land for growing melons should be selected as near the shipping station as possible. It is expensive to haul melons a great distance and the injury from hauling is much greater if they are hauled by truck for several miles.

Wind sometimes causes considerable damage to the young vines. If a windbreak is available it should be used. Many farmers do not turn all the trash under in preparing the land, but leave enough on top for the vines to have some anchorage in case of high winds.

Job 4. Growing Cover Crops. Providing Organic Matter

Conditions Usually Found.—(1) In regions where these crops are grown some form of winter cover crop is usually beneficial. (2) Many farmers fail to provide a special cover crop in their rotation. (3) The need of organic matter in soils is often not fully realized by growers.

Aims.—(1) Students and growers should learn how to provide winter cover crops to precede the growing of melons. (2) They should also work out a suitable rotation for crops to be grown along with melons.

Problems for Study and Discussion.—(1) How many of the farmers who grow melons leave their land bare in winter? Explain or give their reasons.

2. What crops would do well for winter cover crops in your community?
3. Find out whether the local farmers sow cowpeas in the late spring at the last cultivation of the melons.

4. Calculate the difference in expense between providing a cover crop through (a) systematic farm rotation; (b) sowing a special crop.
5. Compare the cost of organic matter in the two forms: (a) barnyard manure; (b) green manure.
6. What are some of the objections to the use of barnyard manure?
7. If barnyard manure is used, when is the best time to apply it?
8. Show the relation of organic matter in soils to moisture control; to the leaching of plant food; and to the buying of fertilizers.

Value of Organic Matter.—Farmers would not be justified in growing cover crops, or in many cases in applying barnyard manure, for their plant-food value alone. The plant-food elements could be supplied as cheap or cheaper by commercial fertilizers. Organic matter, however, is necessary in soils to improve the physical condition. Humus makes clay soils more friable, and fills in the space between the sand particles, making it much more retentive of moisture. Some of the most beneficial forms of bacteria will not thrive in soils lacking organic matter.

Winter Cover Crops.—In good rotations, winter grain serves as a cover crop. In many cases, however, it is necessary to sow some special crop. Winter vetch or crimson clover is usually used. Sometimes vetch is sown in the fall with oats or rye. The plant-food value of a good cover crop of a winter legume is worth approximately one-fourth a ton of nitrate of soda besides the value of the added organic matter and the prevention of leaching and the erosion of the soil.

Job 5. Obtaining Good Seed, Testing and Treating

Conditions Usually Found.—(1) Farmers are sometimes careless in selecting good seed. (2) Poor stands sometime occur because of failure to test the seed before planting. (3) Farmers seldom treat seed for diseases before planting them.

Aims.—(1) The importance of good seed should be learned by students. (2) They should learn how to test seed for vitality and to treat seed for diseases.

Problems for Study and Discussion.—(1) What methods are followed by local growers in obtaining seed?

2. Compare the methods used and state your preference.
3. If melon seed are stored, how long will they keep their vitality?
4. What dangers may result from saving seed where two varieties have been grown near each other? Does it pay to save seed?
5. How much seed is required per acre for each of these enterprises?
6. How would you test seed for vitality?
7. What methods are used in treating seed before planting?
8. What is meant by pedigreed seed?
9. What is standard seed?
10. What is certified seed?
11. What would you be willing to pay for a pound of each kind of seed?
12. Do you know of a wilt-resistant variety? How could such a variety be produced?
13. Would you save seed from your field?

Activities.—Practise testing and treating the seed.

Source of Seed.—Many farmers save their own seed from melons grown on the farm; most farmers, however, depend upon purchasing seed

each year. If the seed is saved on the farm, care should be taken in seeing that only melons which are true to size, shape and color are selected.

Where the seed is purchased care must be exercised in buying them from a reliable seedsman. Do not purchase seed just because they are quoted at a low price. Poor seed means a poor stand and in the long run means a poor yield.

Seed stored in a warm, moist climate will soon lose their vitality. For this reason, care must be taken to keep them in as dry a place as possible and to plant only seed grown the year before.

Amount of Seed to Plant Per Acre.—In planting either one of these crops it is always best to plant more seed than is actually needed so as to allow for injury that may come from frost, insects, or diseases. From 2 to 3 pounds per acre is the rate used by most farmers. Seed planted in the drill will take more than if the check system is used.

Testing Seed for Vitality.—It is always best to find out the percentage of good seed in a lot before planting so that the rate of sowing may be increased in case the seed are of low vitality. The most practical way of testing is to use the rag-doll method. Secure strips of cloth about 12 inches wide and 4 to 5 feet long. Wet the cloth and spread it on the table. Count out about 100 seed and place them evenly over the cloth. Roll up the rag and fasten with a rubber band at each end.

The doll should be soaked for several hours in water and then kept moist and at an even temperature. In a few days unroll the doll and count the number of seed which have germinated.

Treating Seed.—Seed may be treated before planting to kill the spores of injurious diseases, especially those of wilt and anthracnose. These spores stick to the seed and are active on the young growing plants just as they are starting to grow.

Seed may be treated successfully by using one-eighth of an ounce of bichloride of mercury (corrosive sublimate) in a gallon of water. It is best to use a wooden pail for the solution. The seed are placed in the solution and allowed to stay for 4 or 5 minutes. This solution is poison and should be poured out just as soon as the seed have been treated. Trials have shown that Semesan and similar organic materials are even better and safer to use than others (see Appendix).

Job 6. Buying and Applying Fertilizers

Conditions Usually Found.—(1) Farmers usually buy some form of a complete commercial fertilizer for melons. (2) Few farmers mix fertilizers at home.

Aims.—(1) Students should understand the plant-food requirements for melons. (2) They should learn how to work out fertilizer formulas and should be able to mix materials at home if such mixing will pay.

Problems for Study and Discussion.—(1) Find out from the farmers where they secure fertilizers for melons.

2. What fertilizers are used for melons in your community?
3. Do any of the farmers mix fertilizers at home? Why?
4. What influence has fertilization on the quality of melons produced?
5. What disadvantage is there in using barnyard manure for melons?
6. Do farmers in your community side-dress their melon crop? Describe this.

Activities.—Make trials in mixing and applying fertilizers in different amounts and compare results.

Barnyard Manure for Melons.—Barnyard manure is very valuable as a fertilizer for melons but has the one objection that certain diseases may be carried in it, especially if hay from a melon field was fed to the animals producing it. Plenty of humus is essential. For this reason, new land just cleared is good for melons.

The barnyard manure can be applied in furrows or a forkful may be used on either side of each hill. The rate of application varies, but should not be less than from 5 to 10 tons per acre, depending upon the method of applying it. The manure should be applied a week or two before planting the seed.

Commercial Fertilizers.—If no barnyard manure is used, a commercial fertilizer analyzing eight per cent of phosphoric acid, five per cent of nitrogen, and five per cent of potash will make a good fertilizer. The rate of application will depend upon the fertility of the soil and usually ranges from 300 to 1000 pounds per acre. Some growers apply 300 to 600 pounds before planting and then just as the vines begin to run apply about 100 pounds per acre of nitrate of soda or sulfate of ammonia as a side dressing.

How to Apply Fertilizers.—The barnyard manure or the commercial fertilizer applied before planting should not be placed directly under where the seeds are to be planted, unless the fertilizer is well mixed with the soil. If the compost and the fertilizer are placed just to the side of each hill, better germination of seed should be obtained. In applying the side dressing care must be taken not to touch the vines, because of the danger of damage.

Advantages of Home-Mixing of Fertilizers.—If enough commercial fertilizer is to be used, say 8 to 10 tons, a farmer can sometimes save money by purchasing the different fertilizer materials and mixing them. In this way it is possible to make up any desirable formula. Another advantage is that he is certain from what source or sources the different plant-food materials are derived. (See table for mixing of fertilizers in cotton enterprise.)

Job 7. Preparing the Soil for Planting

Conditions Usually Found.—(1) Many farmers wait too long to prepare their land for melons. (2) Soils are often not prepared at all but just ridged for planting.

Aims.—Students should learn the value of a well-prepared seed-bed, and how to prepare it.

Problems for Study and Discussion.—(1) When is the soil prepared for melons in your community?

2. What method of preparing land is followed by farmers?
3. What kind of plow is generally used in preparing the soil?
4. Find out what distances are usually allowed between rows and between hills for watermelons, cucumbers and cantaloupes.
5. How are the rows usually laid off for melons?
6. Describe the use of a disk harrow in preparing soil for melons.

Preparing the Soil.—It is very important that a good seed-bed be prepared. The soil should be prepared several weeks before planting time. Some farmers prepare the land with a tractor and others use mules or horses. An average depth of from 6 to 8 inches should be maintained in turning the land.

Just before planting it is a good practice to harrow the land with a disk harrow, especially land that has a large amount of trash in it.

Most farmers lay off the rows in checks ten or twelve feet apart for watermelons and about five feet each way for cucumbers and cantaloupes. It is also a common practice to plant cucumbers and cantaloupes in the drill in rows five feet apart. Where the check system is used the melons may be cultivated two ways.

Job 8. Planting the Seed

Conditions Usually Found.—(1) The best growers usually understand good methods of planting melon seed. (2) Inexperienced growers do not understand the best methods, particularly of protecting young plants from frosts.

Aims.—(1) Students should understand the advantages and methods of careful planting of seed. (2) They should also know the advantages and methods of securing an early crop.

Problems for Study and Discussion.—(1) Find out the date for planting melons in your community.

2. How many seed do farmers usually plant in each hill?
3. What methods are used by farmers to protect the young plants from frost injury?
4. How deep would you cover melon seed?
5. How many pounds of seed would be needed to plant an acre?
6. What is meant by a replant?
7. Some farmers plant twice in the same hill, planting about ten days apart. What advantage do you see in this practice?

Time to Plant.—Melons of all kinds fail to stand heavy frosts. For this reason, the safe time to plant is just after the danger of frost is over in the early spring. Early melons usually bring the best prices. Cucumbers and cantaloupes are often planted before the danger of frost is over and the young plants protected every night with wooden troughs made by nailing together two planks. In this way, the plants are up and growing

when the last frost is over. Cucumbers are also planted in the fall and winter in certain sections of Florida, the fruit being marketed from November through April or May.

Planting the Seed.—If melons are planted in hills, not less than 12 seeds should be placed in each hill. Farmers find it best to plant plenty of seed and then later thin out the plants. Seed are planted when there is enough moisture in the soil so that germination can start at once.

If the land has just been harrowed and is soft, the seed may be dropped on the soil and covered with the foot or with a hoe. Seed are usually covered about one or two inches deep.

Job 9. Cultivating the Crop

Conditions Usually Found.—(1) Many farmers delay the cultivation of melons too long. (2) Melons are sometimes cultivated when the vines have fruit on them.

Aims.—(1) Growers should learn the value of good cultivation for melons. (2) They should learn good methods, and when to cease cultivating.

Problems for Study and Discussion.—(1) When should the cultivation of melons begin?

2. What implements are used for cultivating melons in your community?
3. Is the thinning of melons practised? Why?
4. Do farmers in your community prune the vines? Of what advantage is this?
5. Is the thinning of fruit practised for watermelons and for cantaloupes in your community? How many fruits are left on each vine?
6. Describe the male and the female flowers of the melon family. Which flowers open first on the vines?

Activities.—Make trials to compare implements used locally as to suitability for these crops.

Cultivating Melons.—The first cultivation is usually given just as soon as the young plants come above the ground. The cultivation for watermelons is usually done with a two-horse cultivator. Sometimes it is necessary to hoe the melons one or two times in wet seasons. Cultivation is usually discontinued just as the vines begin to fruit. After the vines are fruiting damage may be done in moving them for cultivation. This practice may cause the fruit then on the vines to fall off and thereby delay the crop.

Thinning and Pruning.—Melons are usually thinned to one plant to the hill for watermelons. Often two plants are left for cantaloupes and for cucumbers.

In most cases, farmers prune the ends of watermelon vines so that the available plant food may go into the growth of the fruit. The fruit is thinned to leave only one or two melons to each runner. This method gives less melons in number but more are produced of the size which the market demands. Melons weighing less than 18 pounds are practically worthless so far as the market is concerned.

Job 10. Controlling Enemies of Melons

Conditions Usually Found.—(1) Farmers who grow melons usually have to combat plant lice and the striped cucumber beetle. (2) The diseases common to most communities are anthracnose, downy mildew, stem-end rot, and nematodes.

Aims.—Students and farmers should learn to detect each of these insects and diseases and should know how to combat them.

Problems for Study and Discussion.—(1) At what age are plants injured by plant lice?

2. What method or methods do farmers use to control plant lice?
3. At what stage is the striped cucumber beetle apt to injure the plants?
4. How are the striped cucumber beetles controlled?
5. Do farmers have any loss from downy mildew in your community? Describe this disease.
6. Describe a plant that has the wilt.
7. How is wilt controlled?
8. Do you know of any wilt-resistant variety of watermelons? Why should we have such varieties?
9. What losses have occurred in your community from the stem-end rot?
10. How is stem-end rot prevented?
11. Describe the effects on melons of fields infested with root-knot nematodes?

Activities.—Collect and study enemies affecting these crops.

Controlling Insects.—The two main insects which injure the melon crop are plant lice and the striped cucumber beetle. Plant lice appear on the young vines just after they come above the ground and often are able to kill them in a few days. Lice may be controlled by dusting or spraying with nicotine sulfate.

The cucumber beetles have striped wing covers, black heads and yellowish thoraxes. They multiply rapidly and sometimes do great damage both to the vines and to the young fruit. Since the insects eat the vines, leaves and fruit, it is possible to kill them by applying poison. Usually arsenate of lead is mixed with Bordeaux mixture and used in the form of a spray to control both this insect and certain diseases.

Controlling Diseases.—Anthracnose and downy mildew may be controlled by properly spraying the young vines with Bordeaux mixture. Both of these diseases cause black spots to appear on the vines and later on the fruit.

Wilt is caused by a fungus, the spores of which live over in the soil. For this reason, spraying seems to do little good in the control. The disease can be recognized by a vine apparently in good condition dying in a few days. The only safe control known at present is the proper rotation of crops. Melons should never be planted in the same place for the second year. Using varieties somewhat immune to wilt will help.

The stem-end rot is caused by a fungus which enters the mature watermelons through the stem. Melons so infected may all decay in transit. The disease may be prevented by the application of equal parts of starch and copper sulfate with enough water to form a smooth paste.

First dissolve the copper sulfate in water, and make a thin paste with water and the starch. The two solutions are then mixed and boiled until the paste is smooth and of the right thickness. Each melon is treated after it has been placed in the car by cutting the stem afresh and then applying the paste.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—(1) Watermelons are usually cut from the vines and hauled by wagon or by truck to the car for loading. (2) The watermelons are either graded in the field or at the car. (3) Cantaloupes and cucumbers are picked and carried to the packing shed where they are graded and packed for shipment.

Aims.—Each student should understand the importance of careful handling, grading and packing of melons for shipment.

Problems for Study and Discussion.—(1) How can you tell when watermelons are ready for harvesting?

2. How can you tell when cucumbers and cantaloupes are ready?
3. How do farmers get the watermelons from the vines?
4. What precaution do farmers take to prevent injury in handling melons?
5. Describe the methods used by farmers in getting melons to the shipping point.
6. To what extent do the farmers of your community grade watermelons? Cantaloupes? Cucumbers?
7. What is the best size of watermelon for the market demands?
8. How many watermelons are needed to fill a car?
9. Describe how watermelons are packed in the car.
10. How many grades are made of cantaloupes and of cucumbers?
11. Find out the kind of crate used in your community for shipping cantaloupes and cucumbers.
12. Describe how watermelons are treated in the car for stem-end rot.
13. How do you order a car if you want one for shipping melons?
14. What kind of car is used for shipping watermelons? For cantaloupes?

Activities.—Visits should be made to places where harvesting, grading, and packing is being done and their methods studied. Participate in the grading and packing.

When Are Melons Harvested?—Watermelons are harvested just when the meat or flesh is red. Experience is necessary in order to be able to tell when each melon is ripe. This may be told by the sound made by the melon when thumped, by the yellow tinge on the outside of the melon and by the death of the tendril at the stem end of the melon. (Fig. 268.)

Cantaloupes are picked before they are fully ripe, but after they have developed their sugar content. The flesh of the cantaloupe becomes sweet, and later the stem end becomes soft at about the time the melon is fully ripe. They should be picked for shipment just after the flesh is sweet. Cantaloupes will keep over only a few days after they are picked unless they are shipped under refrigeration. A picker without experience will probably have to cut open several cantaloupes in order to learn the exact stage for picking.

Cucumbers are harvested according to size rather than ripeness. They

are picked by hand and the stems left attached to the fruit. The proper length is from 6 to 10 inches (Fig. 269).

Methods of Harvesting.—Watermelons are usually cut from the vines with a knife. The men who cut the melons turn them over or stand

FIG. 268.—Harvesting watermelons. The pickers have placed them on end so the loaders may easily find them. (Agr. Agt. S. A. L. Ry.)

them on end so that they may be easily seen by the other men who load them to the wagon or the truck. The wagon or truck goes down every eighth or tenth row (Figs. 270 and 271).

Cantaloupes and cucumbers are usually pulled by hand from the vines and placed by the picker in lined peach hampers.

FIG. 269.—Harvesting cucumbers grown early by the trough method. (Agr. Agt. S. A. L. Ry.)

Prevention of Injury.—It is very important that melons be handled with the proper care to prevent injury. The wagon or truck for hauling melons is lined with some soft material to prevent bruises. The peach hampers used for gathering the cantaloupes and the cucumbers should also be lined.

Packing Watermelons.—Before loading a car of watermelons care must be taken to see that the car is clean and has been disinfected. Several

inches of clean bedding, such as excelsior, should be placed in the bottom of the car. Native bedding such as pine needles cannot be used from a county which is not free from the cattle tick. The car should also be lined with stiff paper for about three feet of height. Care must be taken, however, not to close the ventilators.

FIG. 270.—Loading watermelons to haul to cars. (R. L. Price.)

A packer stands at one end of the car and the driver comes up to the door of the car with the wagon or the truck. The driver hands the melons to the packer (Fig. 272). The melons are placed side by side in the end of the car with the stem ends toward the center. Usually 14 to 16 are needed for the first row, according to the size of the melons. The second row is placed above and between the melons of the first row, thereby taking

FIG. 271.—Wagonloads of watermelons waiting to be placed in cars. (R. L. Price.)

one melon less. The third row takes the same number as the first. Usually four layers are all that are placed in a car. After the four layers are packed the stems are cut afresh and treated with paste to prevent stem-end rot. Then another row is started and the process continued until the car is loaded. A car will hold from 600 to 1000 melons, according to size. (Fig. 273.)

Packing Cantaloupes.—Cantaloupes are carried from the field to the packing shed where they are graded and packed. Usually the melons

FIG. 272.—Loading melons into cars for shipment. (H. E. Wood.)

are graded into three grades, four-inch, four-and-one-half-inch, and over this size. Crates commonly used are 12 x 12 x 24 inches. These crates

FIG. 273.—A car loaded and ready to move. (H. E. Wood.)

hold about 45 of the four-inch melons and less of the larger sizes. The crate should be so packed that it has a bulge when it is nailed. If possible

the fruit should be picked, graded, packed and placed in the car the same day. For car lots it is best to use refrigerator cars.

Packing Cucumbers.—Cucumbers are sometimes sorted into three grades, No. 1, No. 2, and No. 3. They are classed as small when they are under six inches; medium, 6 to 9 inches; and large when over 9 inches.

The cucumbers are mostly packed in hampers of the one-bushel size. Other types of crate are sometimes used. The cucumbers should be tightly packed so that they cannot move in the package.

Job 12. Marketing Melons

Conditions Usually Found.—(1) Many farmers consign a car of melons to certain cities without knowing who else is doing the same thing. (2) Melons are often shipped to unreliable commission men. (3) Some farmers sell their melons on board cars at the local station.

Aims.—The student should understand the different terms and methods of marketing and the advantages or disadvantages of each system.

Problems for Study and Discussion.—(1) What methods of marketing melons are used by the farmers of your community?

2. What is meant when a car of melons is consigned?
3. Why are melons ever sold on board cars at the local station?
4. What is auction selling?
5. What is meant by an express shipment?
6. What are the causes of a glut in a market?
7. To what extent do the farmers of your community make use of the market news service?
8. Do you have a coöperative marketing association for the marketing of melons? What would be the advantages of such an association?
9. What are the functions of marketing?
10. What would the freight be on a car of melons from your station to New York?

Activities.—Trips should be taken to markets and shipping points. Compare and tabulate prices on different grades of these products.

When are Melons Marketed?—The season for marketing watermelons usually opens in South Florida about the first of May, reaching Georgia the first of June and South Carolina the latter part of June.

Cantaloupes have practically the same season as watermelons. In some cases they are harvested a little ahead of watermelons.

Cucumbers are usually marketed about a month earlier than watermelons. In many cases, cucumbers are on the market early from the section of Florida where they grow "trough cucumbers." In extreme South Florida fall and winter cucumbers are grown and marketed from November on through the winter months.

Methods of Marketing.—In many cases buyers come to the producing regions and purchase the melons as they are loaded in cars. These men may represent certain commission houses in large cities or they may buy the melons to ship to commission merchants, running the risk of price changes. In some cases, large commission firms buy cars of loaded melons, the purchase being made by wire.

Possibly more melons are consigned by the grower to some commission merchant for sale than are marketed in any other one way. This will usually give satisfactory returns if the grower is reasonably certain that he is dealing with an honest firm. One trouble, though, is that too many producers may ship to the same commission firm or to the same city and thereby cause a glut in the market.

Practically all the express shipments of cantaloupes and cucumbers are consigned to commission men.

Job 13. Keeping Records

(See corn enterprise.)

GROWING TRUCK CROPS

Intensifies farming
Increases income
Gives steady income
Requires little capital
Gives quick returns
Requires only small area
Uses school children
Furnishes constant employment
Uses available market
Supplies wholesome food

APPENDIX

REFERENCE BOOKS

Farm Machinery and Shop

Davidson and Chase (Judd)
Kranich (Macmillan)
Radebaugh (Bruce)
Robb and Behrends (Wiley)
Roehl (Bruce)
Schmidt (Century)
Smith (Lippincott)
Struck (Houghton-Mifflin)

Farm Management

Adams (McGraw-Hill)
App (Lippincott)
Myers and Ladd (Wiley)
Warren (Macmillan)

Diseases

Chupp (Macmillan)
Heald (McGraw-Hill)

Insects

Herrick (Holt)
Sanderson and Peairs (Wiley)
Washburn (Lippincott)

Fertilizers

Henkle (Author, Sandusky)
Hopkins (Ginn)
Voorhees (Macmillan)
Wheeler (Macmillan)

Landscape

Hubbard and Kimball (Macmillan)
Simonds (Macmillan)
Van Rensellaer (Scribner)
Waugh (Judd)

Marketing

Jesness (Lippincott)
Boyle (McGraw-Hill)

Soils

Bear (Wiley)
Eastman (Lippincott)
Hunt and Burkett (Judd)
Lyon and Buckman (Macmillan)
Miller (Ginn)
Weir (Lippincott)

Weeds

Georgia (Macmillan)

Woodlot

Cheyney (Macmillan)

Cyclopedias

Bailey, Agriculture (Macmillan)
Bailey, Horticulture (Macmillan)

General Field Crops

Chapman (Smith-Hammond)
Cox (Wiley)
Davis (Lippincott)
Duggar (Macmillan)
Ethridge (Ginn)
Harris (Macmillan)
Hutcheson and Wolfe (McGraw-Hill)
Lathrop (Lippincott)
Montgomery (Lippincott)
Piper (Macmillan)
U. S. Yearbooks
Wilson and Warburton (Webb)

STATE AGRICULTURAL EXPERIMENT STATIONS

Address the director in asking for bulletins and information. The Agricultural College is at the same place, unless starred (*). Write also to the Superintendent of Documents, Washington, D. C., for lists of available bulletins and circulars.

Alabama—
College Station: *Auburn.*
*Canebrake Station: *Uniontown.*
*Tuskegee Station: *Tuskegee.*
***Alaska**—*Sitka.*
Arizona—*Tucson.*
Arkansas—*Fayetteville.*
California—*Berkeley.*
Colorado—*Fort Collins.*
Connecticut—
*State Station: *New Haven.*
Storrs Station: *Storrs.*
Delaware—*Newark.*
Florida—*Gainesville.*
Georgia—*Experiment.*
*Coastal Station: *Tifton.*
***Guam**—*Island of Guam.*
Hawaii—*Honolulu.*
Idaho—*Moscow.*
Illinois—*Urbana.*
Indiana—*Lafayette.*
Iowa—*Ames.*
Kansas—*Manhattan.*
Kentucky—*Lexington.*
Louisiana—*Baton Rouge.*
Maine—*Orono.*
Maryland—*College Park.*
Massachusetts—*Amherst.*
Michigan—*East Lansing.*
Minnesota—*University Farm, St. Paul.*
Mississippi—*Agricultural College.*
Missouri—
College Station: *Columbia.*
*Fruit Station: *Mountain Grove.*
*Poultry Station: *Mountain Grove.*
Montana—*Bozeman.*
Nebraska—*Lincoln.*
Nevada—*Reno.*
New Hampshire—*Durham.*
New Jersey—*New Brunswick.*
New Mexico—*Agricultural College.*
New York—
*State Station: *Geneva.*
Cornell Station: *Ithaca.*
North Carolina—*Raleigh.*
North Dakota—*Agricultural College*
***Ohio**—*Wooster.*
Oklahoma—*Stillwater.*
Oregon—*Corvallis.*
Pennsylvania—*State College.*
Porto Rico—*Mayaguez.*
Rhode Island—*Kingston.*
South Carolina—*Clemson College.*
South Dakota—*Brookings.*
Tennessee—*Knoxville.*
Texas—*College Station.*
Utah—*Logan.*
Vermont—*Burlington.*
Virginia—*Blacksburg.*
Washington—*Pullman.*
West Virginia—*Morgantown.*
Wisconsin—*Madison.*
Wyoming—*Laramie.*

In Canada write to Agricultural College at Guelph, Winnipeg, or St. Anne de Bellevue.* Dominion Department of Agriculture, Ottawa.

AVERAGE COMPOSITION OF BARNYARD MANURES

Barnyard Manures	Pounds per Thousand			Value per Year 1000 lbs. Live Weight	Value per Ton of Manure[1]
	Nitrogen N	Phosphoric Acid, P_2O_5	Potash, K_2O		
Cow manure (fresh)	3.4	1.6	4.0	$39.00	$1.91
Horse manure (fresh)	5.8	2.8	5.3	42.00	3.13
Sheep manure (fresh)	8.3	2.3	6.7	46.00	4.20
Hog manure (fresh)	4.5	1.9	6.0	80.00	2.56
Hen droppings (fresh)	16.3	15.4	8.5		9.12
Mixed stable manure	5.0	2.6	6.3		2.88

[1] Considering nitrogen at 20 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

AVERAGE COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS

(Relative availability, given as q, quick; s, slow; m, medium; v, very.)

Nitrogen Carriers	N%
Cottonseed meal (s)	6
Dried blood, black (m)	6–12
Dried blood, red (m)	13–14
Dried fish (s)	7–9
Dried meat meal (s)	13–14
Nitrate of soda (q)	15–16
Sulfate of ammonia (q)	20–21
Tankage (s)	6–9
Tobacco stems (m)	1.5

Phosphoric Acid Carriers, P_2O_5%	
Superphosphate (q)	14–20
Basic slag (s)	15–20
Bone meal, acidulated (q)	12–16
Bone meal, steamed (m)	25–30
Cottonseed meal (s)	2.8
Dried fish (s)	6–9
Hardwood ashes, unleached (m)	2.4
Rock phos. (Fla.) (v. s.)	18–30
Rock phos. (S. C.) (v. s.)	26–28
Rock phos. (Tenn.) (v. s.)	25–32
Tankage	3–8
Tobacco stems (m)	1.5

Potash Carriers	K_2O%
Cottonseed meal (s)	2.5
Hardwood ashes, unleached (m)	5.7
Kainit (q)	10–13
Muriate of potash (q)	50
Sulfate of potash (q)	48–50
Sulfate of potash (low) (q)	25–28
Tobacco stems (m)	6

Lime Carriers	CaO%
Basic slag (m) old process	40–60
Basic slag (m) new process	0–5
Bone meal, steamed (s)	30–40
Burned lime, fresh (q)	90–100
Ground lime rock (s)	45–50
Hydrated lime (m)	65–70
Marl (s)	20–40
Oyster shells, ground (s)	40–48

PLANT FOOD REMOVED BY CROPS

The data are taken from averages of many analyses of common crops. The amounts are based on yields shown for productive soils. Lower yields will remove proportionally less. The data form a basis for calculating the fertilizer requirements for soils for each crop given. The nitrogen for legumes is in parenthesis, as much of it may come from the air.

Crops	Yields	Nitrogen N	Phosphoric Acid P_2O_5	Potash K_2O	Lime CaO
Alfalfa Hay	5 tons	(238.)	54.	223.	260.
Barley Grain	40 bu. @ 48	35.3	16.3	14.2	1.1
Barley Straw	1 ton	11.2	3.6	24.	6.5
Barley (total crop)		46.5	19.9	38.2	7.6
Beet sugar roots	15 tons	78.	24.	96.	11.
Bluegrass (Ky.)	2 tons	53.2	21.6	84.	17.
Buckwheat Grain	30 bu. @ 50	21.8	15.	10.5	.4
Buckwheat Straw	¾ tons	12.5	1.95	16.95	14.3
Buckwheat (total crop)		34.3	16.95	27.45	14.7
Cabbage heads	15 tons	105.	21.	87.	51.
Clover Hay (red)	2 tons	(82.)	15.6	65.2	87.
Clover Hay, Alsike	2 tons	(82.)	28.	69.6	55.
Clover Hay, Crimson	1 ton	(45.)	12.	45.	55.
Clover, Lespedesa	1 ton	(39.)	21.0	11.0	57.
Corn Grain	65 bu. @ 56	59.	25.11	14.56	1.
Corn stover	1¾ tons	33.	15.75	45.15	17.
Corn Cob	900 lbs.	3.	.63	5.9	.1
Corn (total crop)	4 tons	95.	41.49	65.61	18.1
Corn (for silage)	12 tons	81.6	38.4	105.6	19.
Cotton Lint	500 lbs.	1.5	.3	2.5	.8
Cottonseed	1000 lbs.	31.5	15.	15.	2.5
Cotton (total crop)		33.	15.3	17.5	3.3
Cowpea Hay	2 tons	(124.)	38.4	165.2	50.
Flax Grain	15 bu. @ 60	31.7	13.5	8.5	2.8
Flax Straw	.9 ton	20.6	3.4	18.9	13.
Flax (total crop)		51.3	16.9	27.4	15.8
Hemp (dry stalks)	3 tons	20.	4.	44.	42.
Millet Hay (common)	3 tons	80.	21.6	129.	23.
Oat Grain	50 bu. @ 32	31.7	13.	9.	1.5
Oat Straw	1¼ tons	14.5	5.25	37.5	10.5
Oats (total crop)		46.2	18.25	46.5	12.
Onions (bulbs only)	500 bu. @ 56	60.	25.2	61.6	44.
Pea Grain	20 bu. @ 60	(44.)	10.	12.1	2.8
Pea Straw	1½ tons	(30.)	2.5	26.4	59.6
Peas (total crop)		(74.)	12.5	38.5	62.4
Peas, Green (total crop)	7.5 tons	(85.)	18.	48.	76.5

PLANT FOOD REMOVED BY CROPS—*Continued*

Crops	Yields	Nitrogen N	Phosphoric Acid P_2O_5	Potash K_2O	Lime CaO
Peanuts (shelled)	1000 lbs.	(48.8)	10.2	6.5	
Peanut shells	500 lbs.	(6.)	.7	4.0	
Peanut Hay	500 lbs.	(15.2)	2.5	16.	
Peanuts (total crop)		(70.0)	13.4	26.5	
Potatoes, Irish	200 bu. @ 60	42.0	14.4	63.6	3.4
Potatoes, Sweet	200 bu. @ 50	29.	9.	51.0	
Rye, Grain	25 bu. @ 54	25.5	9.5	7.70	.7
Rye, Straw	1¼ ton	12.0	7.00	19.75	7.7
Rye, Total crop		37.5	16.85	27.45	8.4
Sorghum fodder, dry	4 tons	19.	8.6	32.8	
Soybeans, Grain	20 bu. @ 60	(70.0)	16.44	29.64	3.1
Soybeans, Straw	1 ton	(35.0)	2.4	17.8	45.0
Soybeans, Total		(105.)	18.84	47.44	48.1
Timothy Hay	2 tons	39.6	12.4	54.4	14.1
Tobacco Leaves	1500 lbs.	41.0	12.	96.0	58.0
Tobacco Stalks	1250 lbs.	26.0	18.75	75.00	9.6
Tobacco, Total		67.0	30.75	171.00	67.6
Turnips, Roots	15 tons	66.0	39.0	87.00	21.1
Wheat, Grain	30 bu. @ 60	35.6	15.48	9.54	1.0
Wheat, Straw	1.6 ton	16.0	4.16	23.68	6.0
Wheat, Total Crop		51.6	19.64	33.22	7.0

SEED TREATMENT

The best materials for treatment of seeds are known as organic compounds of mercury, sold under several trade names. The chief one used in trials was Semesan, containing 35 per cent of the compound (mercury-chlor-phenol-sulfate), and may be used as liquid or as dust. Others tried were Bayer dipdust, Uspulun 30 per cent (liquid only), and Semesan Jr., 10 per cent (dust only). Germisan is another trade name of such material.

A number of vegetable crops have been tested at the New York Geneva Station (Bul. 554) and elsewhere. The treatment of seeds aids greatly in the control of seed-borne diseases and in some cases aids in the control of soil-borne diseases. The surprising discoveries are found in the increased percentages of germination in the cases of all vegetable seeds tried except with lettuce and spinach. The greatest increases are found when plantings are made early when soil conditions are unfavorable for rapid germination of seeds. When soils are warm and germination is rapid, seed treatment does not apparently increase the percentage of germination. Treatment to control

seed-borne diseases is recommended. These materials are apparently much preferred in place of formaldehyde, corrosive sublimate, and copper sulfate.

Experiment stations have shown the advantages of treating not only seeds of corn, small grains, sorghums, beets and other root-crops, but also seeds of vegetables of many kinds such as beans, peas, melons, cucumbers, radishes, cabbage, tomatoes, celery, onions, and others.

Treatment with Semesan for one hour in a one-fourth of one per cent water solution is used on spinach, radishes, lettuce, and cabbage. Half an hour at this strength is used for tomato, celery, cucumber and melon seeds. When directions are given on packages they should be followed, as the strengths of solutions and time of treatment vary somewhat.

USUAL DISTANCES APART FOR PLANTING

The numbers of plants required for the limits are given in the last column.

Crops	Rows, Feet Apart	Distance in Rows, Feet	Plants per Acre
Asparagus	3–4	1–2	5444–14520
Beans, bush and pole	2–4	½–1	
Beet, early	1½–2	drills	
Beet, stock, sugar	1½–2	thin drills	
Cabbage, early	2–2½	1½–2	8712–14520
Cabbage, late	3	3	4840
Carrot	1½–2	drills	
Cauliflower	2–2½	1½–2	8712–14520
Corn, sweet, field	3–3½	1–2	6223–14520
Celery	3–4	½–1	10890–29040
Cotton	3½	1½–2	6223–8300
Cucumber and melon	4–6	4–6	1210–2723
Eggplant	3	3	4840
Lettuce, curly	1–2	thin drills	
Lettuce, head	1½	½	58080
Onion	1½–2	drills	
Parsley	1–2	drills	
Peas, cowpeas, soybeans	1–3	drills	
Peanuts	2½–3	1	14520–17424
Pepper	2½	1½	11616
Potato, Irish	2½–3	1–1½	9680–17424
Radish	1–1½	drills	
Rhubarb	4	2–4	2722–5445
Salsify	1½–2	drills	
Sorghums	3–4	1–3	3630–14520
Spinach	1–1½	drills	
Squash and pumpkin	6–8	6–8	680–1210
Sugar cane	4	1	10890
Sweet potato	3–4	2	5445–7260
Tobacco	3–4	1–3	3630–14520
Tomato	3–4	3–4	2722–4840
Turnip	1½–2	drills	

QUANTITY OF SEED PER ACRE, AND LEGAL WEIGHTS.

Name of Seed	Amount per Acre	Lbs. per bu. Usually
Alfalfa	20 lbs.	60
Barley	8–10 pks.	48[1]
Beans	3– 6 pks.	60
Blue grass, alone	20–25 lbs.	14
Buckwheat	3– 5 pks.	48[2]
Clover, alone, red	10 lbs.	60[3]
Corn, shelled, checkrow	6– 8 qts.	56[5]
Corn, for ensilage	10 qts.	
Cotton, Upland	4– 8 pks.	32[4]
Cowpeas	4– 6 pks.	60[5]
Flaxseed	2– 4 pks.	56[5]
Mangels	5– 8 lbs.	
Millet	1– 3 pks.	50[5]
Oats	2– 3 bu.	32[5]
Oats and Canada peas	5– 6 pks. each	
Onions	5– 6 lbs.	52–57[5]
Peas, field		60
Potato	6–18 bu.	60[5]
Potatoes, sweet, bedded	1½– 3 bu.	46–60
Rice, rough	1– 3 bu.	43–45
Rye	3– 8 pks.	56[5]
Soybeans	4– 6 pks.	60[5]
Sweet Clover (scarified)	18 lbs.	60
Timothy	15 lbs.	45[5]
Timothy and clover mixture	10–12 lbs. each	
Turnips or rape	3– 5 lbs.	60
Vetch and grain mixture	4– 5 pks. each	
Vetch, Augusta	3– 4 pks.	60[5]
Wheat	6– 9 pks.	60

[1] Pennsylvania 47. Varies in a few states from 45 to 50.
[2] Varies in different states from 42 to 56.
[3] New Jersey 64.
[4] Varies 28 to 33⅓.
[5] A few exceptions.

CROP YIELDS AND FARM PRICES IN THE UNITED STATES

Crop 1926	Acreage	Average Yield per Acre	Production	Farm Price per
Hay Crops		*Tons*	*Tons*	*Ton*
Alfalfa hay	11,057,000	2.49	27,496,000	
Annual legume hay	3,490,000	1.09	3,797,000	
Clover hay	7,402,000	1.38	10,185,000	
Timothy hay	8,884,000	1.16	10,273,000	
Tame hay	58,840,000	1.47	86,378,000	$14.09
Wild hay	13,506,000	.74	9,984,000	10.07
Grain and Root Crops		*Bushels*	*Bushels*	*Bushel*
Barley	8,200,000	23.3	191,182,000	$ 0.57
Beans	1,659,000	10.3	17,138,000	2.93
Buckwheat	707,000	18.3	12,922,000	0.88
Corn	99,492,000	26.6	2,645,031,000	0.64
Flaxseed	2,897,000	6.7	19,459,000	1.94
Irish potatoes	3,151,000	113.1	356,360,000	1.41
Oats	44,394,000	28.2	1,253,739,000	0.40
Peas (field)	36,820	66.7	2,454,000	2.18
Rye	3,513,000	11.4	40,024,000	0.83
Sorghum, Grain	4,410,000	22.8	100,710,000	0.55
Sweet Potatoes	830,000	100.8	83,658,000	0.96
Wheat	56,526,000	14.7	832,305,000	1.20
		Pounds	*Pounds*	*Pound*
Peanuts	852,000	735.8	626,866,000	0.04
		Short Tons	*Short Tons*	
Sugar beets	685,000	11.0	7,537,000	
Truck Crops		*Crates*	*Crates*	*Crate*
Asparagus	85,640	89.3	7,645,000	3.00
Cantaloupes	103,160	136.0	14,038,000	1.29
Celery	24,270	268.7	6,523,000	1.91
		Bushels	*Bushels*	*Bushel*
Cucumbers	107,410	81.9	8,801,000	1.33
Onions	74,560	276.6	20,625,000	.76
		Tons	*Tons*	*Ton*
Cabbage	125,760	7.9	997,400	17.91
Tomatoes	375,950	3.7	1,388,800	13.93
		Car	*Car*	
Watermelons	199,560	0.34	69,551	

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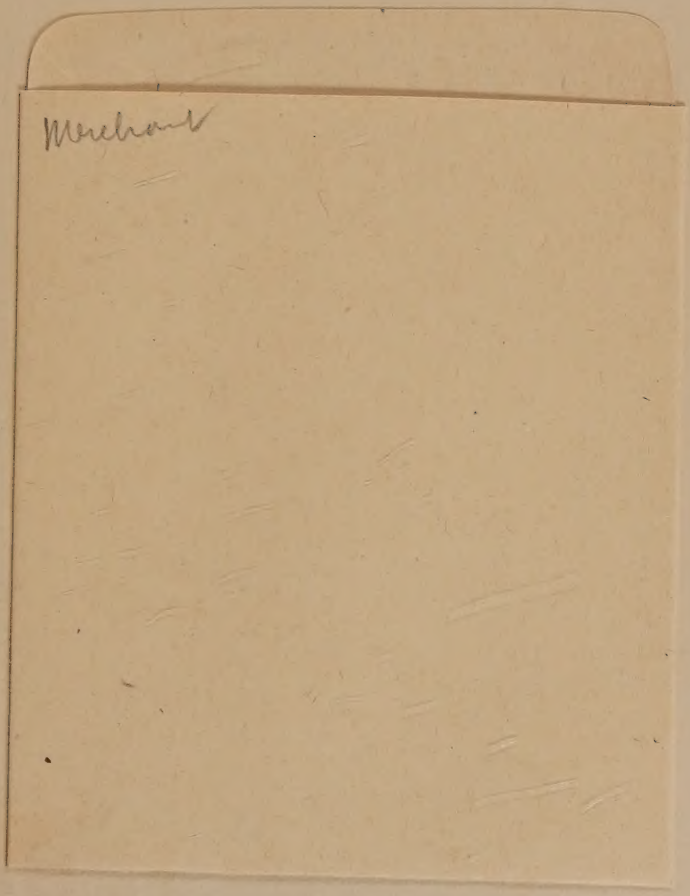
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